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ARTICLE

Pharmacy in a German death camp: the life and work of Franciszek Adamanis (1900-1962)

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Abstract

This article describes the life and work of a Polish pharmacist, Franciszek Adamanis (1900-1962), focussing on his professional activities under the extreme conditions of a death camp. During the Second World War he was arrested by the Germans and taken to a death camp in Austria. There he produced parenteral fluids clandestinely in an attempt to save inmates, and carried out research to determine the origins of pyrogens. The article also examines his post-war scientific, organisational and social achievements. The study is mainly based on published memories of ex-prisoners of the Mauthausen-Gusen extermination camp, on Adamanis's own publications, and on records from the Archives of Poznan University of Medical Sciences and the Museum of Pharmacy in Poznan, Poland.

Figure 1. *Franciszek Adamanis, 1950. Unknown author (Source: Magowska photographic collection)*

Early years

Franciszek Adamanis was born on 4 October 1900 in Liepaja; today it is situated in Latvia, but until 1795 it was a Polish town and its inhabitants were mostly Poles. He was one of the six children of Antoni, a railway worker, and Teresa (née Laudańska), in a patriotic family of practising Catholics. Franciszek's carefree childhood ended with the outbreak of the First World War in 1914. When the Eastern Front drew closer to Liepaja, the Adamanis fled to the town of Gomel (today in Belarus), where Franciszek graduated from secondary school.

In 1918 Poland regained her independence after Russia, Prussia and Austria-Hungary had annexed its territory for 123 years. Contrary to expectations, Liepaja and Gomel remained outside its borders; hence, the family decided to repatriate themselves to Poland. They settled in Poznan, because there the newly opened university offered excellent opportunities for children's education. Franciszek enrolled in the law department, but he could not begin his studies straightaway. Firstly, his father's premature death deprived him of material support, and thus of the possibility to pay tuition fees. Secondly, Bolshevik Russia unexpectedly attacked the eastern borderlands of Poland, and volunteers were needed for the armed units that were to stop the advancement of the Red Army. Franciszek volunteered for the army and fought as a private. He was discharged from the army in September 1921, when the political situation was normalized.

He decided to return to Poznan, but to study pharmacy rather than law. He took on the job of a clerk, and after three years saved the money needed for his university fees. As a student, he had to earn his living and make money for further fees, so he went to lectures and laboratory classes during the day, and in the evenings he oversaw accounting for various small companies. In 1926, he married his fellow student, Janina née Ferchmin (1900-1993), which prompted him to look for a better-paid job. He found a job in a small chemical factory, from where he moved to the Akwawit company, specializing in the production of alcohol and alcohol-based industrial products.[1] A year later, he received a master's degree in pharmacy. His thesis, 'About Heintz's aldol and its obtaining' – written under the supervision of Professor Konstanty Hrynakowski (1878-1939) – was awarded the medal of the University.[2 3]

Scientific career

As an experienced technologist, Adamanis soon became the manager of the factory. This position was very lucrative and ensured that a five-roomed company apartment and a company car were at his disposal. But this idyllic

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life ended in 1930. In the face of the global economic crisis, the supervisory board decided to liquidate the factory. Overnight, Franciszek, together with his wife Janina, two daughters and his mother, found themselves on the street, deprived of an apartment and any income.[4]

At the time, it was difficult to get a job, so the couple decided to temporarily separate. Janina – with her children and mother-in-law – went to the distant town of Chełmża, where she found a job in a pharmacy managed by a friend. Franciszek stayed in Poznan and lived with his sister. He obtained a modest income from commissioned lectures on the taxonomy of poisons, and laboratory classes in pharmaceutical chemistry conducted at the Department of Pharmaceutical Chemistry of the University of Poznan run by Professor Hrynakowski. In 1931, Adamanis took the position of assistant professor and was appointed to a team searching for new drugs using the thermal analysis of combinations of organic compounds. It was an innovative approach on a global scale.[5]

Adamanis presented the results of his research in a dissertation entitled 'Thermal and optical analysis of some organic compounds', as a result of which he was awarded a PhD diploma in 1932.[6] [7] Four years later he became an associate professor thanks to work he undertook, in which he proved that the biological activity of chemical compounds depended on their spatial structure and hydrogen bonds. Thereafter, he earned more money, which allowed him to rent an apartment and to bring his family back to Poznan.[8] He participated in international conferences, which ensured citations of his publications.[9] [10]

At Hrynakowski's request, he began to organise the Department of Toxicological and Forensic Chemistry. He was supposed to go to Paris for an internship to learn the latest methods of toxicology, but the sudden death of Hrynakowski in 1938 shattered those plans. Adamanis took his place as the head of the Department of Pharmaceutical Chemistry. However, the Second World War broke out, and he had to face much more difficult challenges.[11]

In the Mauthausen-Gusen camp

Ten days after the outbreak of the war, German troops occupied Poznan to incorporate not only this city but also the entire west-north part of Poland into the Third

Figure 2. *The Mauthausen-Gusen death camp, 1945. Unknown author (Source: Magowska photographic collection)*

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Reich as the Warta Country ('Reichsgau Wartheland'). In turn, the south-eastern regions of Poland were recognised by Germany as its protectorate, and were called the General Governorate for the Occupied Polish Territories ('Generalgouvernement für die besetzten polnischen Gebiete'). In November 1939, the Germans started to relocate Poles from the Warta Country to the General Governorate or concentration camps. The Poles displaced to the General Governorate were left there without any help or care, so they supported each other by creating the structures of the Polish Underground State. The Poles taken to German extermination camps tried to do the same, although organising the resistance movement there was much more difficult and often impossible.

On the night of 20-21 April 1940, the Gestapo arrested many representatives of the Poznan intelligentsia, including Franciszek Adamanis, to celebrate Adolf Hitler's (1889-1945) birthday. The occupiers took them to a concentration camp ('Konzentrationslager Posen') established in one of Poznan's forts.[12] After a few days, the Germans transported Adamanis to the Dachau concentration camp, and from there to the death camp ('Sterbelager') in Mauthausen-Gusen in Austria. It was a Grade 3 camp ('Stufe III'), which meant that the harshest conditions prevailed there, and the prisoners had little chance of survival.

Figure 3. *Crematorium in the Mauthausen-Gusen death camp, 1945. Unknown author (Source: Magowska photographic collection)*

The Mauthausen camp was, in fact, a system of subcamps, one of which – created in 1938 after the annexation of Austria by the Third Reich – was situated in Gusen. The location on the hill and the surrounding high wall made it look like a fortress. The prisoners worked mainly in the nearby quarry, where they extracted granite needed to redesign major German cities. The reason for the camp's existence was not the exploitation of granite, however, but the elimination of political and racial enemies of the Third Reich. The Nazis defined as such all educated Poles who revealed their patriotism. But not only Poles were persecuted: Russians, Spaniards, Yugoslavs, Frenchmen, Czechs, Belgians, Italians, Greeks and representatives of other nationalities were also brought to this place, amongst whom a significant number of Jews was noticeable.[13]

After entering the camp, they had to strip naked on the assembly ground. Then they were shaved and disinfected. Their clothes, shoes and all personal belongings were taken; in return, they were given white and blue striped uniforms with a number assigned to each person, and heavy, wrong-size clogs. During this camp initiation, they were abused and often beaten by the guards, who were exclusively SS-men.[14 15]

In Mauthausen-Gusen, the Germans forced prisoners to do exhaustive physical work, with daily starvation rations consisting of half a litre of ersatz coffee (made of unspecified organic material) in the morning, less than a litre of thin soup at noon, and a slice of black bread – sometimes with a piece of sausage, margarine, a spoonful of cottage cheese or marmalade. Under these conditions, a healthy and strong man could survive no more than half a year. In 1942, the Germans built a gas chamber from which the corpses of the gassed were transported to a crematorium. Piles of human ashes always heaped up near the crematorium.

At the beginning of 1943, prisoners were sent to work at the nearby underground aircraft assembly plant of Messerschmitt ME 262 fuselages.[16] They became essential and, probably for this reason, the Germans allowed them to receive food packages from their families. In the last period of the camp's existence, when the Germans began to withdraw from the occupied territories, the parcels stopped reaching the addressees, and the situation of the prisoners worsened again. Loss of physical strength and, notably, nervous breakdowns reduced the chances of survival.

In the social engineering experiment that was a concentration camp, the block elders and the kapos played a significant role. These were Nazi concentration camp prisoners who were given privileges in return for supervising prisoner work gangs; they were usually recruited from criminal offenders who had previously served long sentences in Germany. Kapos were people of a sadistic disposition who were given the power to inflict violence and cruelty on other prisoners, who were deprived of any rights, and were only numbers in the camp community.[17]

Prisoner number 49416

Franciszek Adamanis received the number 49416. He was assigned to work in the quarries as a 'Steinträger'

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(carrier of rock blocks), and after some time transferred to the construction of railway tracks. He starved, was beaten and tortured, but survived thanks to a fellow prisoner, Władysław Gębik (1900-1986), who was a graduate of the University of Poznan. When the Germans ordered Gębik to create a commando group that was able to participate in the excavations at the Spielberg Castle on the Danube, he selected the Polish prisoners who were teachers or scout leaders, intending to make them the core of the resistance movement in the camp. Adamanis was assigned to this commando group.[18]

Soon, an underground organisation was established, whose most important goal was to strengthen the mental and moral fibre of the prisoners so that they would not break down despite experiencing hunger, cold, illness and violence. All sabotage and education efforts, every reminder of human dignity and moral values, as well as concentrating the prisoners' thoughts around the idea of building a better world, were necessary. Collective prayers, self-help activities as well as ideological, scientific and literary discussions were organised. There were no conditions in the camp for conducting a broader campaign, but much could be done during the walk to the quarries or other places of work. Members of the underground organisation tried to exhibit altruistic behaviour in the same way as Adamanis, who gave an exhausted prisoner his piece of bread, for which the SS punished him with twenty-five blows of a bullwhip.

Adamanis's special task within the underground movement was to maintain communication with representatives of other nationalities, and for this reason he was called the 'Minister of Foreign Affairs of the Republic of Gusen'. In this way, an increasing number of prisoners were included in the resistance network. Scholars and teachers interned in the camp contributed to the so-called 'Walking University'. Whenever possible, they gave lectures in various fields of science and taught foreign languages. Adamanis learned French, German and Spanish, and gave lectures on pharmacy and chemistry. He also taught Russian and participated in discussions on philosophical topics.[19]

A game of chess as a game for life

When the archaeological search at Spielberg Castle was completed, Adamanis – due to his excellent command of the Russian language – became a Writer (this was the designation given to the person in charge of prisoners' lists) in Block Number 16, called a 'camp hospital', intended for Soviet prisoners of war. However, the name 'camp hospital' was misleading, because it was not a place of treatment but for unethical medical experiments. Moreover, emaciated prisoners who were to be gassed or killed with a phenol injection were held there. When the all-Russian prisoners of war were murdered, Adamanis was transferred to Block Number 31 – also called a 'camp hospital' but designated for prisoners of different nationalities. Here, the prisoners received half the food rations, and the block guards killed the most exhausted prisoners with phenol injections.

This block turned out to be a convenient place of contact for the camp conspirators, because it contained a dissecting room. The Germans never entered it because they were afraid of typhus and tuberculosis, the most common causes of death. The dissecting room was run by Polish physicians Antoni Gościeński (1909-1986) and Feliks Kamiński (1902-1958). As a pre-war assistant professor in the Faculty of Medicine of Poznan University, Kamiński knew Adamanis. The conspirators also met in the dentist's office, because a queue of prisoners was something frequently seen there.[20]

Nevertheless, a prerequisite for organising any underground activities was tolerance on the part of the German kapos. As long as Franz Zach and Heinrich Roth – both known for their cruelty – acted as these prisoner functionaries, the operation of a secret organisation was not possible at all. However, in early 1942, Zach was transferred to another camp. The underground organisation then decided to liquidate Roth, who suffered from bouts of bad temper, during which he strangled prisoners by kneeling on their chest, or killed them with phenol injections. The conspirators resorted to intrigue. They warned a German SS doctor that Roth was dangerous and was planning to give him a lethal injection. One night, the doctor pre-empted Roth and injected him with poison.[21]

Heinrich Käfferbeck became the new block elder. He distinguished himself by the fact that he not only read the works of German poets and philosophers but also expressed himself in a language betraying some education. He was obliged to enter prisoners who did not show any health improvement straight onto the 'death list'. Chess was his passion. When Adamanis learned about this, he sculpted chess pieces from a piece of pistachio wood found accidentally, and played games with the block elder for hours, diverting his attention from selecting prisoners. Whenever Käfferbeck won, he was in such a good mood that – at Adamanis's request – he did not enter prisoners who had a chance to recover on the 'death list'. Adamanis organised long chess tournaments, inviting other prisoners who also tried to play with the elder to lose, because it could save some prisoners. The actual stake in the game was human life.[22]

Gościeński and Adamanis implored Käfferbeck to write his 'death list' only once a week, and to make it available to them before executing the sentence. They

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gained the opportunity to save the lives of those who had even slim chances of being cured. Käfferbeck only wanted to follow his superiors' instructions. He never wondered why the prisoners he selected were not lying on the beds intended for those waiting for the gas chamber. Gościeński and Adamanis put only the sick whose prognosis was bleak in these beds.[23]

Adamanis's next task was to keep double medical records in order to hide those prisoners who, due to the extended duration of treatment, were in danger of the sentence being executed. Still another task was to secretly stop the medical experiments carried out by Dr Gustav Bömichen on prisoners suffering from tuberculosis, which consisted of the administration of chemical preparations manufactured by I.G. Farben. These pseudo-medications first caused a deterioration of health and then the death of the prisoners. After the interruption of experiments, the patients were strengthened with vitamins smuggled in double-bottom packages and with the intravenous administration of calcium chloride. After some time, their health improved, which Bömichen contentedly attributed this to the medical experiments.[24]

Illegal laboratory

Block Number 31 initially received sparse allocations of several drugs and primitive paper bandages, but at the beginning of 1943, the Germans stopped distributing even these modest supplies. At that time, Adamanis took on the responsibility of providing parenteral fluids, although he risked his life by doing so. Thanks to his good relationships with Käfferbeck, he had some freedom of action. It allowed him to gather the necessary equipment: an iron furnace in the infirmary, an autoclave in the operating room (German doctors conducted medical experiments there), a dozen empty ether bottles, a large measuring cylinder, a flask, a glass funnel, a glass rod (used as a device for determining density of liquids), a 250ml syringe, and enamel bowls intended for food but used to store drug solutions. The laboratory did not meet any quality standards but created a chance to save fellow-prisoners.

There was also a 'hospital pharmacy' in the camp, which was provided with industrial chemicals; hydrochloric acid, calcium carbonate and activated carbon. The prisoner who was in charge of the pharmacy secretly gave some quantities of these chemicals to Adamanis. On the other hand, he received small amounts of glucose and afenil (a combination of calcium chloride and urea to treat tuberculosis) smuggled in food parcels from his wife.

Without an analytical scale and a hydrometer, he invented his own method of control of parenteral fluid concentration, by comparing the density of the tested solution with the density of the standard fluid, which was a 10 percent solution of calcium chloride from ampoules also smuggled in packages from his wife. With a rod, he took a drop of standard liquid and added it to the tested solution, assessing the concentration based on diffusion currents. He prepared the medications for parenteral administration with tap water, because he did not have another liquid. In secret, he produced about 200 injections of 10 percent calcium chloride solutions and 50 glucose and afenil solutions per week, so about 25,000 units in total. He produced medicinal carbon from activated carbon, which helped to treat the diarrhoea caused by hunger or typhus.

Occasionally, prisoners experienced a sharp increase in body temperature after parenteral fluids. Adamanis knew that it was the effect of pyrogens, whose origin was unknown at the time. So he started experimenting. He filtered some of the fluids through activated charcoal and sterilised some in an autoclave. He found that carbon-filtered fluids always caused a significant rise in body temperature. However, no such shocks occurred after administration of sterilised fluids which had been autoclaved, although the glass became cloudy and brittle after being heated several times. Admixtures present in chemicals did not cause the spikes in temperature. Storage of ready-made drug solutions in enamelled food bowls was not a problem either. Fortunately, the fluids produced in the secret laboratory improved health and prevented many prisoners from being gassed.[25]

After the war, the discussion about the origins of pyrogens arose in the global scholarly literature, and Adamanis published an article about his experiences in the extermination camp. In another work, he described how he solved the problem of a jammed metal plunger in the only syringe he had. The syringe had to be cooled to unblock the plunger.[26]

With the help of the resistance movement, Janina Adamanis was able to smuggle even letters written in Polish. In turn, she received a moving gift; her husband's portrait, drawn by a prisoner and sent without the censorship of SS-men (this was possible thanks to the camp resistance movement). In the same way, Franciszek sent letters to her. But this famished, exhausted and battered man did not write about his suffering.[27] He wrote instead about beauty as a higher degree of love:

> Beauty is what corresponds to inner human nature, its aesthetics, ethics, etc. Measuring with the measure of life and looking at various matters and things from a distance, I conclude that beauty is in ourselves, around us, everywhere, at every step, you only need to want and see it, to know how to take it.[28]

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From April 1944, the first transports of Polish children and young people arrived at Gusen. Adamanis was one of the prisoners helping them and organising extra food. The caretakers of the young prisoners were not capable of obtaining additional food rations for them, but by asking those who received food packages, they were able to coax a piece of bread. In the evening, the members of the resistance movement distributed bread. Subsequently, young people were included in underground celebrations of patriotic anniversaries and literary evenings.[29]

Figure 4. *Portrait of Adamanis in a secret laboratory in Gusen, by a fellow prisoner, about 1944. Unknown author (Source: Magowska photographic collection)*

The liberation of the camp and return to Poznan

In the autumn of 1944, news from the war fronts reached the prisoners. Afraid of the camp pacification, they established a new secret organisation called 'Military Operation'. Its task was to prepare the prisoners to fight in defence of their lives. Obtaining a weapon was impossible, so they planned to blow up the camp wall and escape. Franciszek Adamanis undertook to produce the explosive. He worked at night in his laboratory. With darkened windows, he produced nitro-glycerine from available chemicals, i.e. from concentrated nitric and sulphuric acids and glycerine. The resulting grey substance was mixed with sand and sawdust, then packed into tin cans and buried in the ground.[30]

As it turned out later, the Germans intended to cover the tracks of the extermination camp by gassing the prisoners in underground tunnels and then blowing them up. However, they failed to carry out their murderous intentions. In fear of the approaching American troops, they fled the camp in a hurry on 5 May 1945. A few hours later, soldiers of the Third US Army commanded by General Patton arrived at the camp.

The Americans found thousands of people who were emaciated by hunger and hard work, many of whom required hospitalisation and special nutrition. With the assistance of the Americans, a hospital was created in the nearby Linz for exhausted ex-prisoners and those unable to return home. For three months Adamanis ran a hospital pharmacy for them. In retrospect, the Mauthausen-Gusen camp was indeed a place of mass extermination. In 1938-1945, the Germans brought here about 200,000 people, out of which less than 20,000 survived.[31]

Figure 5. *Portrait of Adamanis, by a fellow prisoner, about 1944. (Source: Magowska photographic collection)*

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It took Adamanis two weeks to return to Poznan because there was no timetable, and the trains ran irregularly. He greeted his wife with a wedding ring, which, at great risk to his life, he had been hiding in a knot of string used as a belt in Gusen. This ring – a sign of cordial closeness to Janina – gave him the strength to survive. Janina, together with her children, mother-in-law and other relatives, survived the German occupation in Poznan. Fortunately, there was a shortage of auxiliary staff in the pharmacies taken over by the Germans, so she quickly found a job in one of them.

When the eldest daughter of Adamanis – Antonina – turned twelve, the occupiers sent her to work as a babysitter in a German family. She was overburdened and mistreated, which resulted in severe heart and kidney disease. A year later, her younger sister, Barbara, turned twelve. To protect her from the same fate as Antonina, some friend employed her in a trading company. The youngest Krystyna stayed alone at home for days. Franciszek's mother died in 1944.[32]

The post-war development of pharmacy

When Franciszek Adamanis came back to the Department of Pharmaceutical Chemistry, he saw rooms roughly cleared of debris by his colleagues, but without windows, furniture and equipment. The condition of the rooms was proportional to the destruction of the entire building, which had been bombed in 1942 by the British Royal Air Force because it was the seat of the German Air Force Command. Moreover, deuterium – a component of nuclear weapons – was being produced in the laboratories unlawfully appropriated by the Germans; the laboratories were incorporated into the Reich University created in April 1941. Nevertheless, on 1 September 1945, Adamanis resumed lectures in pharmaceutical, toxicological and forensic chemistry.[33]

Adamanis also held the position of deputy director of the School of Pharmacy, and after its transformation into the Faculty of Pharmacy, Vice Dean and later Dean. He was Vice-Rector too. He did not shirk working in university committees.[34] There were no Polish textbooks on antibiotics and other newly discovered drugs, so he published three volumes on these topics.[35] [36] [37] The war caused a break in the continuity of education, which is why Adamanis was keen to deliver papers on the progress of pharmaceutical chemistry for members of scientific societies.[38]

Adamanis was a workaholic and encouraged his assistants to carry out intensive research. Every day he visited them and asked about the results obtained, in order to analyse them together. At regularly held scientific meetings, assistants had to present preliminary research findings, which created an opportunity to discuss emerging problems. The professor never had any free time, but as he loved young people, he always found time for them.[39]

During the years 1948-1950, at the behest of the state authorities, he also managed one of the departments of the State Institute of Medicinal Plants in Poznan. After the sudden death of its director, he ran it for four years and researched medicinal plants. Another duty that the state authorities entrusted to Professor Adamanis was to organise postgraduate training for pharmacists in Warsaw.[40]

Still other tasks resulted from the introduction of the Act on Pharmaceuticals, Narcotics and Sanitary Articles of 1951, which obliged pharmacists to run quality control laboratories in pharmacies for the medicines they manufactured themselves and those that had recently entered the market. Adamanis was then a regional consultant for pharmaceutics and was responsible for the implementation of the Act. He periodically visited pharmacies.[41]

He was a chairman or member of various Polish scientific bodies and societies. These included the Medical Section of the Main Council of Higher Education, the Pharmaceutical Sciences Committee of the Polish Academy of Arts and Sciences in Krakow, the Pharmaceutical Sciences Committee of the Polish Academy of Sciences, the Polish Pharmacopoeia Committee, the Polish Pharmaceutical Society, and he was a foreign member of the American Pharmaceutical Association.[42]

Ambivalent reports

After the war, Adamanis enjoyed considerable moral authority. His superiors praised his ability to reconcile many duties and entrusted him with new ones. This was a very deliberate policy of the communist authorities. In post-war Poland, non-communist party scientists who were openly religious – and Adamanis was – had no chance of retaining their jobs at the University.

Franciszek Adamanis was one of the few survivors of the Gusen concentration camp who returned to the homeland and adapted to the new political realities. Before the war, he had a neutral worldview, and in the camp resistance, he did not join any political fraction. After returning to Poland, he became an icon of the struggle for peace and other universal values that the communists often extolled. They needed Adamanis to build credibility in a Polish – and mostly religious – society which was reluctant to accept Marxist ideology. For example, Adamanis's name was next to that of communist party activists on the list of candidates for local structures of state authorities.[43]

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After almost five years in the Mauthausen-Gusen camp, his health was poor, but he did not defend himself against involvement in politicised campaigns. After returning from Linz, he was admitted to the Polish Association of Former Political Prisoners of Nazi Prisons and Concentration Camps. It was not until June 1958 (that is, two years after the political thaw in Poland) that deeply religious Adamanis became a full professor.[44]

Figure 6. *Franciszek Adamanis as Dean of the Faculty of Pharmacy of the Medical Academy in Poznań, 1951. Unknown author (Source: Magowska photographic collection)*

Despite the atmosphere of intimidation, Adamanis never renounced his faith. When in 1960, as part of the fight against the Church, the Polish government carried out the operation of removing crosses from public places, a delegation of students belonging to the communist youth organisation came to Adamanis, who was then the Vice-Rector. They requested him to remove crosses from the lecture halls and the laboratory. He refused. He said that he had not hung them, so he would not remove them. They remained in place until the end of his life.[45] After a difficult life, internment in the extermination camp, and being overloaded with professional duties after the war, he died prematurely on 14 April 1962 at the age of 61, and was buried in Poznan.[46]

Conclusion

The memory of Franciszek Adamanis as a gentleman who loved life and was faithful to the mission of pharmacy endures in various ways. He had a street in Poznan named after him. An academic library was named after him, as well as a statuette which is awarded to people recognised for distinguished service in the field of pharmacy.

The story of the secret production of parenteral drugs in the German extermination camp has not previously been told outside of Poland. Nevertheless, it represents a timeless example of the kind of selfless contribution that pharmacists can make to their fellow citizens, and constitutes an inspirational example of what can be achieved by those involved in pharmaceutical education.

We need heroes in pharmacy and role models to guide personal actions and behaviours. Adamanis acted against the law imposed on him, guided by his empathy and professional competence. Personal motivation and virtues are necessary for pharmacy practice. Education in this area is more complicated than passing on the knowledge of the main principles of professional ethics. It should be implemented by methods appropriate for the anticipated learning outcomes, by describing and discussing cases of heroism, such as that described in this article.

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Endnotes and References

1. Magowska, A. Franciszek Adamanis (1900-1962) – farmaceuta. In: Meissner R. and Hasik J. (eds) *Szkice do portretów przedstawicieli medycyny poznańskiej 1945-1985.* First edition. Poznan: Wydawnictwo AMiKM, 1991: 109-111.

2. Adamanis, F. O aldolu Heintza i jego otrzymaniu. *Roczniki Chemii.* 1928: 8; 349-357.

3. Szmytowna, M. Działalność naukowa i dydaktyczna profesora dr Franciszka Adamanisa. *Acta Poloniae Pharmaceutica.* 1963: 20; 101-108.

4. Malejka-Giganti, D. Professor Franciszek Adamanis (1900-1962) – 'A Man for All Seasons'. In: Grzeskowiak, E., Jelinska, A. and Zajac, M. (eds) *Uroczystość 90-lecia Wydziału Farmaceutycznego Uniwersytetu Medycznego im. Karola Marcinkowskiego w Poznaniu oraz Ogólnopolska Konferencja Naukowa*. First edition. Poznan: Wydawnictwo UMP, 2010: 107-115.

5. Archives of Poznan University of Medical Sciences, DSP 120/134, Adamanis's CV., 1947, pages unnumbered.

6. Adamanis, F. Analiza termiczna pewnych związków organicznych. *Roczniki Chemii* 1933:13; 351-359.

7. Szmytowna, M. (Note 3) 1963: 20; 101-108.

8. Pawełczyk, E. Charakterystyka działalności naukowej Profesora Franciszka Adamanisa. *Poznańskie Roczniki Medyczne.* 1992-1994: 16-18; 149-154.

https://doi.org/10.24355/dbbs.084-202009111211-0

9. Hrynakowski, K. and Adamanis, F. Les systèmes ternaires des composes organiques et leur classification. *Trabajos del IX Congreso International de Quimica Pura y Aplicada*. Madrid 1934: 6; 267-280.

10. Hrynakowski, K. and Adamanis, F. Das Verhalten der Amino-Gruppe in Systemen Festflussig organischer Komponenten, *Atti del X Congreso Internationale di Chimica*. Roma 1938: 202-206.

11. Zając, M. and Jelińska, A. Mgr farm. Janina Adamanis (29.08.1900-4.04.1993) i prof. dr hab. Franciszek Adamanis (4.10.1900-14.04.1962) – niezwykli farmaceuci. *Farmacja Polska*. 2016: 72; 719-736.

12. Wardzyńska, M. *Był rok 1939. Operacja niemieckiej policji bezpieczeństwa w Polsce. Intelligenzaktion*. Series: Monographs. First edition. Warszawa: IPN, 2009: 190.

13. Gushee, D. *The Sacredness of Human Life: Why an Ancient Biblical Vision is Key to the World Future*. First edition. Grand Rapids, Michigan/Cambridge: William B. Eerdmans Publishing Company, 2013: 313.

14. Brenneis, S. J. *Spaniards in Mauthausen. Representations of a Nazi Concentration Camp, 1940-2015*. First edition. Toronto: University of Toronto Press, 2018: 107-110.

15. Littner, K. *Life Hanging on a Spider Web: From Auschwitz–Zasole to Gusen II*. Ed. Haunschmied, RA. First edition. Norderstedt: Gusen Memorial Committee 2011: 286-289.

16. Schmidt, A. and Loehrer, G.(compiled). *The Mauthausen Concentration Camp Complex: World War II and Postwar Records. Reference Information Paper 115.* First edition. Washington, DC: National Archives and Records Administration, 2008: 35.

17. Madoń-Mitzner, K. *Ocaleni z Mauthausen. Relacje polskich więźniów obozów nazistowskich systemu Mauthausen-Gusen*. First edition. Warszawa: Dom Spotkań z Historią, 2011: 7-8, 12-13.

18. Dobosiewicz, S. *Mauthausen-Gusen: samoobrona i konspiracja*. First edition. Warszawa: Bellona, 1980: 151-179.

19. Zając M. and Jelińska A. (Note 11) 2016; 72: 719-736.

20. Dobosiewicz, S. (Note 18) 1980: 151-179.

21. Dobosiewicz, S. (Note 18) 1980: 151-179.

22. Gębik, W. *Z diabłami na ty: w obozach Tapiau, Hochenbruch, Stutthof, Sachsenhausen i Gusen*. 1st ed. Gdańsk: Wydawnictwo Morskie, 1972: 208.

23. Gaziński, W. *Wróg. Pięć lat i jeden dzień w Dachau i Gusen*. First edition. Poznan: Systherm Service, 2003: 248-249.

24. Dobosiewicz, S. (Note 18) 1980: 151-179.

25. Adamanis F. Pyrogeny w płynach iniekcyjnych. *Farmacja Polska*. 1949; 5: 219.

26. Zając M. and Jelińska A. (Note 11) 2016; 72: 719-736.

27. Museum of Pharmacy in Poznan, Collection of manuscripts, the memories of Janina Adamanisowa entitled 'Dla nas słońce nie zachodzi', 1965: 14.

28. Zając, M. and Jelińska, A. (Note 11) 2016; 72: 719-736.

29. Gaziński W. (Note 23) 2003: 248-249.

30. Dobosiewicz, S. (Note 18) 1980: 151-179.

31. Dobosiewicz, S. (Note 18) 1980: 151-179.

32. Archives of Poznan University of Medical Sciences, DSP 120/134/049, the questionnaire of Franciszek Adamanis, 1958, unnumbered pages.

33. Szmytówna, M. Wkład pracy pomocniczych pracowników nauki i pracowników technicznych przy uruchomieniu zakładów i pracowni chemicznych ówczesnego Oddziału Farmaceutycznego Uniwersytetu Poznańskiego na II piętrze Collegium Chemicum przy ul. Grunwaldzkiej 6 w 1945 r. *Acta Medicorum Polonorum*. 2017: 7 (2); 85-89.

34. Płotkowiak, Z. Professor Franciszek Adamanis jako wychowawca i społecznik. *Poznańskie Roczniki Medyczne*. 1992-1994: 16-18; 155-160.

35. Adamanis, F. *Podręcznik chemii farmaceutycznej*. First edition, volume 1, Warszawa: PZWL, 1951.

36. Adamanis, F. *Podręcznik chemii farmaceutycznej*. First edition, volume 2, Warszawa: PZWL, 1953.

37. Adamanis, F. *Podręcznik chemii farmaceutycznej*. First edition, volume 3, Warszawa: PZWL, 1956.

38. Archives of Poznan University of Medical Sciences, DWF 4210/415, the minutes from the proceedings of the Pharmacy Faculty Board, April 12, 1958, p. 5.

39. Płotkowiak, Z. (Note 34) 1992-1994: 16-18; 155-160.

40. Malejka-Giganti D. (Note 4) 2010: 107-115.

41. Płotkowiak, Z. (Note 34) 1992-1994: 16-18; 155-160.

42. Zając, M. and Jelińska, A. (Note 11) 2016: 72; 719-736.

43. Archives of Poznan University of Medical Sciences, DSP, 121/134/049, the register of University staff, about 1952, unnumbered pages.

44. Archives of Poznan University of Medical Sciences, DSP 120/135, the personal data card of Franciszek Adamanis, 1960.

45. Museum of Pharmacy (Note 27) 1965: 33-35.

46. Zając, M. and Jelińska, A. (Note 11) 2016: 72; 719-736.

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ARTICLE

Carl Warburg (1804-1892) and his fever tincture: The rise, fall and revival of a secret remedy

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Abstract
From the 1830s onwards, German-born self-styled physician Carl Warburg (1804-1892) propagated a secret remedy against fever that allegedly contained an extract from a newly discovered plant which he claimed was superior to cinchona bark. This article follows the journey of Warburg's Tincture from British Guiana to England and Austria, and finally back to England. It illustrates how – with dogged determination and high level connections – the inventor was able to maintain a remarkably high level of interest in both himself and his product over more than fifty years.

Figure 1. Moritz Richard Schomburgk, botanist. (Source: State Library of South Australia, Adelaide, Portrait Collection, item B5676)

Introduction
Richard Schomburgk (1811-1891)[1] was a dedicated lover of nature who one day met 'the destroying angel of the tropics'.[2] (Figure 1). That morning in 1840, soon after his arrival in Georgetown on the banks of the Demerara River,[3] a 'dull oppressive headache' awakened him from sleep.[4] A morning walk did not result in the desired improvement, and as his strength gradually failed, he experienced difficulties in making his way back to his lodging. The headache intensified and insufferable pains in the back tortured him. His brother Robert[5] rushed for quinine and calomel. The latter was stopped after the onset of laxation, while quinine was repeated every two hours thereafter. Next day, when the patient regained consciousness, 'they had already shaved my head and spread the whole back of it and nape with a Spanish-fly plaster'.[6]

Alas, the fever still increased and 'during the most critical stage, they had given me within a couple of hours two bottles of champagne, had packed my whole body in ice, and wrapped it round with towels soaked in ice-water'. On the fourth day the 'appearance of the black vomit consisting of a coffee-like evacuation' and a sudden burst of blood from mouth and nose, which could only be arrested after six hours, indicated that Schomburgk was in the final stage, and that there was no more hope. Miraculously, however, he recovered, and was 'for twenty years the first case in Georgetown that had survived an attack of yellow fever after onset of the black vomit'.[7]

At a time before bacteria, viruses and other kinds of micro-organisms were identified as pathogens, fever was not seen as a symptom but rather as a disease in itself. It was often accompanied by intensified sensations, disorientation and even delirium, hence being – as Christopher Hamlin put it – 'more than hot'.[8] As early as the eighteenth century pathologists were able to distinguish more than one hundred different kinds of fever and arrange them by their putative relationship.[9] Some of those responded to the cinchona bark or quinine while others did not, all in all leaving a huge demand for new and more effective febrifuges.

'Un liqueur febrifuge'
Not surprisingly, medical men all over Europe took great interest in a letter read before the Académie des Sciences in Paris on 18 January 1836.[10] The French traveler, Adam de Bauve,[11] reported having been healed from a fever that resisted the febrifuges usually employed, and even the sulphate of quinine. A certain 'Dr Warburg, a physician, cured him with a preparation, the composition of which he did not make known'… 'The success of this remedy in the hospitals of British Guiana, as well as in several of the Antilles, and even in the United States of America, seems to leave no doubt of its efficacy'.[12] As de Bauve wrote, the discoverer – appraised 'for his disinterested care of the fever patients, who were almost all cured in a few days' – would be eager to disclose his secret if recompensed for it by the French government.

Later, in pamphlets intended to propagate his nostrum, Carl Warburg gave his version of his days in Demerara. During ten years he had established friend-

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ly relations with the native Indians, and with their assistance he 'penetrated far into the interior of that country, and made frequent excursions, sometimes of several months' duration, into those wild regions, in search of New Plants, many of which [are] hitherto unknown in Europe'. And with some deprivation, danger and effort, finally his 'labours were crowned with success' as he found a remedy superior to quinine.[13]

Contemporaries in Georgetown had quite a different perception of him,[14] as 'Dr Warburg was not known here as a botanist or herbalist or working chemist' but as a medical doctor 'with little practice, endeavouring to make known and sell his nostrum'. However, he was said to be 'a person of excellent address and of convivial talents and an admirable player on the guitar'. Along the way he made the acquaintance of a Captain Halliday and his father Sir Andrew Halliday (1782-1839)[15] – who was appointed Deputy Inspector-General of hospitals in the West Indies in 1832 – but he had to return to Scotland in 1837 due to ill health (Figure 2).

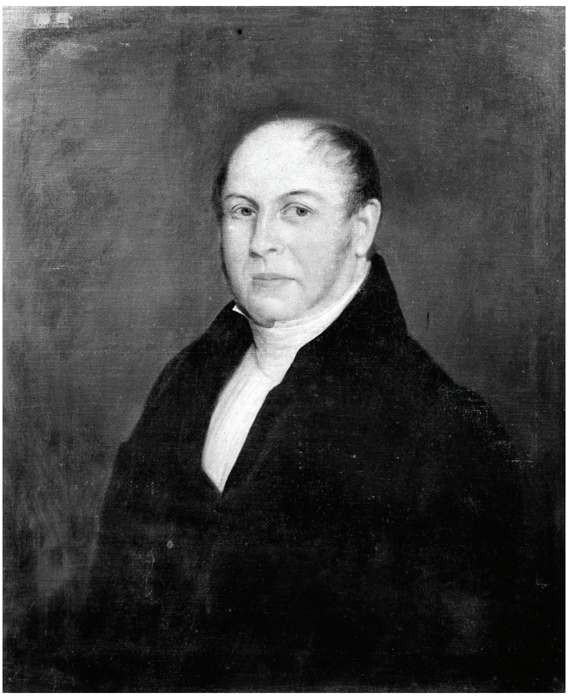

Figure 2. *Sir Andrew Halliday, physician. (Source: Wellcome Library, London, item fyvy5dz3)*

A physician of very superior talents

As early as 1835 Sir Andrew Halliday reported on a new substitute for cinchona and sulphate of quinine, that had been discovered some years earlier by Hugh Rodie Esquire, a former Surgeon in the Navy, who settled in Demerara in 1814 as a general practitioner of medicine.[16] Halliday calls Rodie 'my esteemed friend' and 'a very excellent practical chemist', who despite his extensive and lucrative practice preferred 'the solitude of the woods … to watching the progress of disease in the chambers of the sick at Demerara'.

After many fruitless trials he had discovered that the bark of a tree – *Bebeeru,*[17] as the Indians called it – contained 'all the sensible qualities of the cinchonas'. Rodie then produced 'a concentrated solution of what I would beg leave to call the Sulphate of Bebeerine', which was found to 'possess the medical qualities of the quinine in a very eminent degree'. Halliday ends by 'recommending his [Rodie] being granted … a monopoly of the bebeeru tree … for the next twenty years'.

In 1839 Sir Andrew gave a distressing report on the miserable conditions troops in the West Indies had to live in, which gained some attention.[18] Annual mortality was as high as 4 percent, with fever being the cause of almost half of the fatalities.[19] Again, Halliday turns to a newly discovered febrifuge, but now – to our surprise – it is that promoted by Warburg, who he describes as a 'physician of very superior talents and a man of keen observation, a botanist of some distinction and well acquainted with modern chemistry'.

Warburg's preparation had been tested in diseased soldiers 'with the most perfect success'. It required of Warburg 'great trouble and great expense in bringing to perfection these invaluable drops,' and he had supplied gratuitously larger quantities for testing purposes. Based on the positive results of trials, Warburg felt that he was 'entitled to some remuneration for the time he has consumed, and the money he has expended, in procuring so important a benefit for the whole human race'.[20]

In London, Sir Andrew introduced Carl Warburg – who had also returned to Europe – to the publisher of his book,[21] John William Parker.[22] Both agreed to the marketing and distribution of Warburg's Fever Drops.[23] An 'address to the public', together with an extract of Halliday's report, some newspaper reports from the West Indies and the obligatory series of letters of thanks, was published as an eight-page separate print in 1839. Warburg assured readers 'that the public may place the fullest reliance upon the genuineness of my Fever Drops, as prepared at the Laboratory of Messrs Parker and Company, King William Street, Charing-Cross' under his direct supervision.[24] (Figure 3).

Apparently, he made Parker believe that he was in the possession of 'thirty-two puncheons[25] of extract – the effective ingredients for three million bottles' – stored in a secret place.[26] The prospect for a net profit of £600,000 persuaded Parker to spend about £3,000 for advertisement. But Warburg – who already intended to move to Germany – proved to be unable to fulfil his part of the contract,[27] and the partnership was finally dissolved in December 1841.[28]

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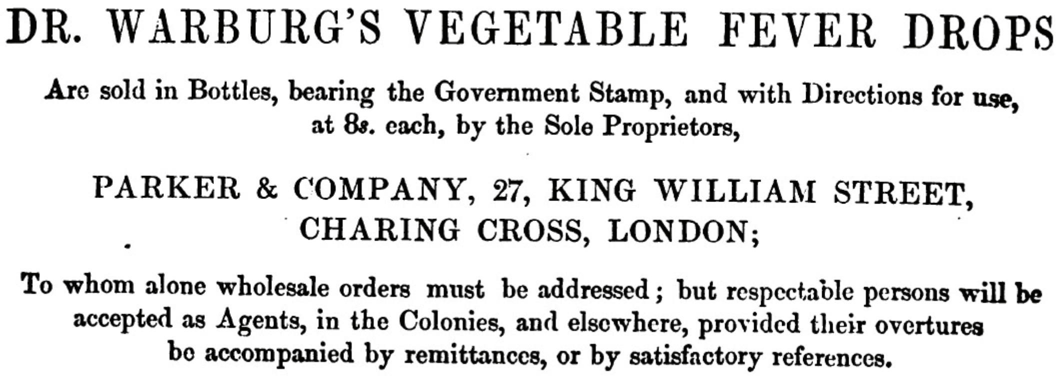
DR. WARBURG'S VEGETABLE FEVER DROPS

Are sold in Bottles, bearing the Government Stamp, and with Directions for use, at 8s. each, by the Sole Proprietors,

PARKER & COMPANY, 27, KING WILLIAM STREET, CHARING CROSS, LONDON;

To whom alone wholesale orders must be addressed; but respectable persons will be accepted as Agents, in the Colonies, and elsewhere, provided their overtures be accompanied by remittances, or by satisfactory references.

Figure 3. *Parker & Company. Advertisement 1839. (Source: see Note 13)*

A positive secret remedy

In 1843 another pamphlet was published in the German city of Mainz.[29] In it, *Dr Warburg's Vegetable Fever Drops* were described as a 'positive secret remedy', containing – as proved by chemical analysis – neither metals nor quinine, morphine or strychnine. According to reports from patients and doctors, its effects were said to be corroborating like cinchona, exhilarating like serpentaria, resolving and purging like rheum and aloe, and all in all 'a specific that could not be replaced by any substitute'.

Physicians were invited to request free samples from Carl Warburg in London or from his brother F[ranz] Ch[ristoph] Warburg in Mainz. In return they were asked to publish their (positive) results in the medical press. The appraisal of that 'balm so precious for suffering mankind' could not go unopposed. A sarcastic commentary told of a young merchant from Mainz who several years earlier had a wonderful dream in which he 'put the doctor hat' on himself and ended up as the 'conqueror of fever'. In fact, there is no evidence to date that Carl Warburg obtained any regular medical training.[30]

In 1844 several bottles of Warburg's Drops that a 'gentile straniero' had brought with him from India to Bologna were applied to patients with varying degrees of success. In the mid-1840s Carl Warburg was located in Vienna, where persons in the highest of positions such as Prince Clement de Metternich – the Counsellor of State – supported his intentions. With a highest-level decree from 17 July 1846, all public hospitals in the city and its surroundings were ordered to subject Warburg's Drops to a clinical trial, while Warburg himself was directed to provide his medicine for that purpose free of charge.[31]

A booklet, purportedly intended to instruct doctors on the clinical trials, was merely a propaganda pamphlet that already anticipated the desired results. The constituents of the preparation were now said to be 'alcoholic extracts from four plant species endemic to the West Indies, still unknown to botanists in Europe'. Warburg reached the pinnacle of his success when on 30 January 1847 his drops were declared by the highest decree to be 'approved as a pharmaceutical preparation for use by doctors in all Austrian states', even before the final results of clinical trials were available.[32]

Chemical analysis: precipitation and re-crystallisation

But clouds were already appearing on the horizon. In 1843/44 the German pharmacists Ferdinand Ludwig Winckler (1801-1868)[33] and Johann Andreas Buchner (1784-1852)[34] independently analysed the Fever Drops upon the request of physicians. Both were able to identify quinine by alkaline precipitation and re-crystallisation to the sulphate. Almost at the same time the customs in Lombardy – which then belonged to the Habsburg empire – seized a larger quantity of the respective preparation, which was handed over to the medico-surgical-pharmaceutical faculty at the University of Pavia.

A commission of five doctors also isolated the sulphate of quinine, and stated that camphor, saffron, aloe and eventually opium and rheum were likely to be among the other ingredients, which made the matrix of the mixture resemble the traditional *elisire lunga vita*.[35] This is also in accordance with the findings of Winckler and Buchner, who saw similarities regarding outer appearance and pharmacological effects with the former *Spiritus theriacalis*[36] and the well-known *Elixir proprietatis*.[37] As some doubt fell on the results of the commission, the analysis was repeated in August 1845 under the continuous supervision of Ferdinando De Cattanei di Momo (1796-1864), professor of general

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chemistry and pharmacy in Pavia. The needle-shaped crystals isolated from Warburg´s Drops and an authentic sample of sulphate of quinine were both subjected to twelve different reactions, each showing identical results.[38]

Austrian authorities apparently did not take any notice of these results, but instead allowed Warburg to reduce the message of Winckler, Buchner and others to 'vegetable ingredients only' without mentioning the major finding that his Fever Drops – allegedly more effective and better tolerated than quinine – contained large quantities of precisely that substance.[39] In the time of Vormärz – the period of German history before the revolution of 1848 – even scientific life was severely hampered by the Austrian regime. Hence the k. k. Gesellschaft der Ärzte (Association of Physicians) was only able to constitute in 1837, but soon also served as a forum for medical opinions deviating from the official one.

In December 1846 Ignaz Pach (1789-1861), head of the Vienna based Apothekerhauptgremium (Main Board of Pharmacists) reported to the pharmacological section on his analysis.[40] According to him, the unloved nostrum contained a considerable amount of quinine and a minor quantity of camphor, but certainly no other alkaloids or arsenic compounds. Early in 1847 a 'generic' mixture based on Pach's results was reportedly being therapeutically tested with positive results. However, other physicians gave accounts of disappointing outcomes with Warburg's original tincture.

Later that year the Board of Pharmacists set up a commission to further investigate the preparation in three sub-groups. All of them agreed that quinine was the major ingredient but, as with other scientists before, they came to different conclusions on the remaining compounds.[41] The pharmacist Josef Fuchs – leader of one of the working parties – also published the composition of another suitable substitute.[42]

An excellent remedy

The clinical trials as ordered by the government were directly supervised by Protomedicus Joseph Johann Knolz (1791-1862),[43] the highest medical officer of the Austrian state. Knolz, who also wrote a book on the systematic taxonomy of fevers,[44] became personally acquainted with Warburg and, due to a positive experience, was a strong supporter of his Fever Tincture. Publication of results started in March 1847 and took several months and dozens of pages.[45]

As expected the preparation proved to be 'an excellent remedy for the treatment of intermittent fever' and other conditions as suggested by Warburg.[46] Practically all physicians gave it a positive review, some though with quite critical nuances. There were reports of therapeutic failure and side effects. Occasionally therapy was switched from the tincture to a better tolerated medication upon the patient's request. Some physicians even tried the Fever Tincture themselves, and thus were able to comprehend the criticism of patients. Others for ethical reasons refused to use the drug in very severe disease. The high rate of spontaneous healing in certain kinds of intermittent fever was discussed, and the necessity of further trials was emphasized.

In autumn 1847 Ludwig Riegler, head of the fourth medical department at the k. k. Militär-Garnisons-Hauptspital (central military hospital) reported on successful trials with a *Tinctura antifebrilis nosocomialis militaris,* only consisting of simples listed in the military pharmacopoeia.[47] It perfectly resembled Warburg's Fever Drops, which were sold at 30 kr. C.M. per 2 fluid ounce bottle[48] – 25-times the cost of the ingredients of the new substitute.

Revolution and some side effects

The German Revolutions of 1848-49 – the opening phase of which was called the March Revolution – hardly fulfilled the hopes placed in it. Nevertheless, Austrian pharmacists felt an atmosphere of optimism, where all at once it seemed possible to execute an agenda long overdue – a hope that was soon to be disappointed. But the time had come for a final settlement on nostrums like Warburg's Fever Drops. Only a few months previously the publication of a critical account had been oppressed by the authorities.[49] But now the granting of privileges for nostrums like Warburg's could be publicly criticized as 'a sad sign of regression' and an instance of maladministration.[50]

Meanwhile, Carl Warburg found himself in an unfavourable situation. Chancellor Metternich, already aged 75 years, was forced to resign in March 1848 and was on his way to exile in London; other supporters were also no longer at hand. In September Warburg tried to improve his condition by donating a large quantity of his preparation to the army.[51] But things turned even worse, when Croatian troops were ordered to Vienna to combat the revolt in late October.

Severe fighting took place near the Prater area and Warburg´s site at Jägerzeile (today, Praterstraße) – a safe distance from the city centre – was burned down (Figure 4). Warburg wrote of having lost 'all my stock of medicine, ready for issue, (a large quantity, I can tell you) as well as all my vegetable extracts yet remaining in this country' and therefore decided to 'use the utmost possible dispatch to get to London'.[52]

He departed in February 1849, leaving behind his wife Helena, who went bankrupt in July.[53] Resuming

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Figure 4. *Fighting at Jägerzeile, Vienna, 1848 (Grosser Kampf bei der Jägerzeile am 28 Oktober 1848, Heinrich Gerhardt). (Source: Österreichische Nationalbibliothek, item: oai:baa.onb.at:18784483)*

his time in Vienna, Warburg states in a letter dated December 1848 that 'the great object of my life' – the official recognition of his remedy by governmental authorities – 'that for which, as you know, I have toiled, in and out of Europe, for the last twenty years, is now at last, to a certain extent, accomplished'.[54]

A Herculean task

In London, Warburg tried to get back into business by renewing his partnership with Parker – to whom the letter was addressed – and by means of material and contacts from his time in Vienna. Parker, Furnivall and Parker served as publishers of a 90-page booklet on 'Official documents relative to the trials of Warburg's Fever Tincture'.[55] Warburg expressed hope that, considering data of the previous trials, 'there will be little or no opposition in England, on the ground of the medicine being, for the present, a secret one'. But still he saw 'a Herculean task before me in my attempt to obtain the confidence of the British Medical public in a new therapeutic agent'.[56]

This was a task that could not be accomplished without higher support. Through his former patient Count Emmanuel von Mensdorff-Pouilly (1777-1852),[57] who was related to both Prince Albert and Queen Victoria, his concerns were brought before the Queen, who then enabled contact with her personal physician, Sir James Clark (1788-1870).[58] Thereupon Benjamin Guy Babington (1794-1866)[59] at Guy's Hospital, and Southwood Smith at the London Fever Hospital, were ordered to submit Warburg's Tincture to clinical testing.[60]

In a letter published in June 1851 the inventor of the tincture turned 'to my professional brethren in England to give some account of its history'.[61] But patent medicines – once seen as a positive option somewhere between quack nostrums and conventional medicine in Georgian times –were now severely opposed by physicians.[62] Hence, when Warburg's letter was printed in the *Medical Times*, the Editor critically remarked that 'we cannot refrain from expressing our conviction that those physicians who have used a remedy of, to them, unknown composition – a nostrum and therefore a quack medicine – lost sight of the position they hold, and the respect due to the College of which they are members'.[63] This opened a vivid and extensive discussion, which also shone some new light on Warburg's time at Georgetown and on his early London years (as already discussed above).

John Davy (1790-1868),[64] referring to his colleague Daniel Blair, then Surgeon General in British Guiana, reported that Warburg's Tincture was 'said to be made

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from an Indian plant as a substitute of quinine', that it was never was a success there, and that it was believed to consist of 'quinine disguised probably by tincture of aloes'.[65] Babington, who had seen good success with Warburg's Tincture, and in defence of that medicine made the point, that at least three articles in the pharmacopoeia also were secret remedies and six or seven common remedies were of unknown origin regarding the plant species they were derived from.[66]

He also emphasized Warburg's financial disinterestedness, as 'he does not puff his remedy by advertisement – he does not sell it – he does not in any way endeavour to make it a source of pecuniary profit'.[67] The Editor of the *Medical Times* replied that Babington 'must have been grossly deceived, [as] Dr Warburg not long since opened a depot for the sale of a specific for continued fever, remittent fever, intermittent fever, consecutive dropsy, and neuralgia'. He again condemned commercial activities by physicians,[68] and closed with the plaintive yet futile words: 'This nostrum mania must be cured'.

A curious specimen of polypharmacy

In 1870 Warburg was still struggling for recognition of and remuneration for his remedy, this time by means of a booklet with a rather lengthy title.[69] The author lamented that – even 34 years after its discovery – his tincture still was rather unknown, and that, based on prejudices, 'so many lives have been sacrificed to the etiquette of the medical profession'.[70] He then turned to his present conditions of living 'at which generosity at the expense of the necessities of life must cease' and declared himself unable to divulge his secret for free as 'a noble act of philanthropy'. As compelling evidence no longer could be ignored, Warburg gradually changed his position by starting to 'neither acknowledge nor deny the presence of quinine as an ingredient'.

One of the most convinced supporters of Warburg's Tincture was William Campbell Maclean (1811-1898), Professor of Military Medicine at the Royal Victoria Hospital in Netley, near Southampton.[71] In 1866, in a monograph on malarial fevers, he stated that in accordance with the whole profession he deprecated the use of secret remedies. But as 'it is no secret that quinine enters largely into this combination and is its most active ingredient', he recommended its use, as he had 'seen it in at least thirty cases treated by myself cut short severe remittents after one or two exacerbations'.

Maclean further stated that he did 'not hesitate to recommend that careful trials should be made of this remedy', but with caution being required, since 'if given indiscriminately in the manner recommended by Warburg I am confident its use must often be disastrous'.[72] In 1876 Maclean was reported as having 'just come back from Rome where he has cured himself of an attack of Roman fever' by means of Warburg's Tincture.[73] (Figure 5).

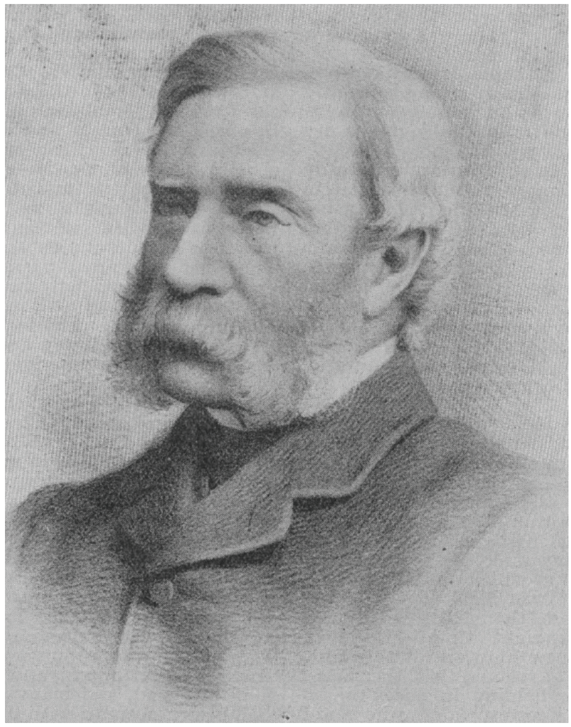

Figure 5. *William Campbell Maclean, physician. (Source: British Medical Journal. 19 November 1898: 1977; 1591)*

In 1875 Warburg entrusted him with the task of disclosing the composition of his remedy, probably expecting to constitute at least a moral claim to a well-deserved and obviously urgently needed financial compensation.[74] Maclean at first referred to his positive experience, and then disagreed with critics who had described Warburg's Tincture as 'only quinine concealed in a farrago of inert substances for purposes of mystification'. He finally gave a formulation listing 15 ingredients, one of which, *Confectio Damocratis*, itself consisted of 44 individual simples.

This idea was not totally new, as in his account on the fevers the Scottish physician William Grant (1755-1786)[75] already recommended a mixture of cinchona, rheum and that confection as a potent febrifuge.[76] Suspicion arises, however, that the now disclosed formula of Warburg's Tincture might have been polished and enlarged for the purpose of publication, to let self-production seem less attractive and to assure purchase was made from the inventor. In any case, it is completely implausible that such a complex product could have been prepared in the remoteness of the West Indies in the 1830s without anyone being aware of it.

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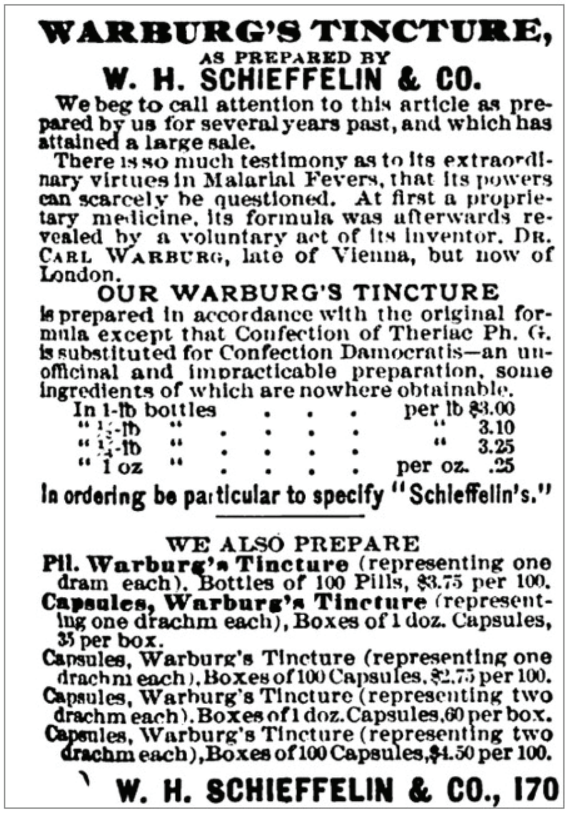
In 1876 the preparation of a modified tincture, consisting of plants readily available in India, was proposed,[77] while Maclean again gave notice of the difficult situation that Warburg was in, since 'the sale of his tincture is the only thing that in his old age stands between him and starvation'.[78] In 1878 readers of the *British Medical Journal* were informed that the poor Carl Warburg undeservedly lived in miserable conditions.[79] In 1885 Maclean – who somehow felt guilty for Warburg's poverty, since 'this well-intended act of mine [the publication of the formulation] was followed by disastrous results to the inventor' – appealed for donations.[80] Similar activities took place in 1890, and a small weekly pension was granted to Warburg.[81] Finally, in 1892 Carl Warburg died in London at the age of 87.

A preparation of remarkable longevity

Some authors rejected Warburg's Tincture as 'apparently a most unscientific remedy, an egregious piece of poly-pharmacy, a remedy at which science must stand aghast, or turn away in disgust, for the multitude of its ingredients'.[82] But others extolled the purported pharmacodynamic and pharmacokinetic advantages of that mixture, as 'in the tincture quinine is readily and quickly absorbed, and being powerfully stimulant, waking the malaria-dulled nervous forces to activity'.[83] And others tried to simplify the preparation by omitting ingredients that were no longer available, or by totally replacing *Confectio Damocratis* by a more convenient preparation.[84]

Reports of travellers and in fiction illustrate the immense popularity of Warburg's tincture at the end of the nineteenth century. In 1876 the Governor General of Sudan, Charles George Gordon (1833-1885), also known as Gordon Pasha,[85] who was 'very satisfied with that remedy' donated several bottles to the German-Russian explorer Wilhelm Junker (1840-1892).[86] The famous explorer David Livingstone (1813-1873) reported that 'we had a good supply by the kindness of one of our nobility; but I am compelled to say that it did not answer our expectations'.[87]

According to the German anthropologist (Karl Johann) Otto Schellong (1858-1945)[88] the remedy was also popular in the South Sea 'after a respected English missionary uttered the bold word that 'Warburg's Tincture never failed', while Schellong himself could not agree.[89] The American author John Kieran (1892-1981),[90] who spent his childhood at The Bronx – at the time an area of endemic malaria[91] – remembered that 'every morning, before we had a bite of breakfast, a big jug of brown and bitter-tasting liquid called *Warburg's Tincture of Quinine* was brought out from the dining room closet. Each had to swallow about an ounce of the stuff from a small glass as a preventive. Despite this daily dosage, we all suffered considerably from recurrent malaria, and so did most of our neighbours'.[92]


WARBURG'S TINCTURE,
AS PREPARED BY
W. H. SCHIEFFELIN & CO.
We beg to call attention to this article as prepared by us for several years past, and which has attained a large sale.
There is so much testimony as to its extraordinary virtues in Malarial Fevers, that its powers can scarcely be questioned. At first a proprietary medicine, its formula was afterwards revealed by a voluntary act of its inventor. DR. CARL WARBURG, late of Vienna, but now of London.
OUR WARBURG'S TINCTURE
is prepared in accordance with the original formula except that Confection of Theriac Ph. G. is substituted for Confection Damocratis—an unofficinal and impracticable preparation, some ingredients of which are nowhere obtainable.

In 1-lb bottles . . .	per lb $3.00
" ½-lb "	" 3.10
" ¼-lb "	" 3.25
" 1 oz "	per oz. .25

In ordering be particular to specify "Schieffelin's."

WE ALSO PREPARE
Pil. Warburg's Tincture (representing one dram each). Bottles of 100 Pills, $3.75 per 100.
Capsules, Warburg's Tincture (representing one drachm each), Boxes of 1 doz. Capsules, 35 per box.
Capsules, Warburg's Tincture (representing one drachm each), Boxes of 100 Capsules, $2.75 per 100.
Capsules, Warburg's Tincture (representing two drachm each). Boxes of 1 doz. Capsules, 60 per box.
Capsules, Warburg's Tincture (representing two drachm each), Boxes of 100 Capsules, $4.50 per 100.
W. H. SCHIEFFELIN & CO., 170

Figure 6. *W. H. Schieffelin & Co. advertisement 1886. (Source: see Note 82)*

Figure 7. *Warburg's Tincture c.1860 found in Wilmington, North Carolina (Source: Internet)*

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Conclusion

Whilst Warburg's life ended in poverty, his tincture retained a surprisingly durable place in the materia medica over the decades. We find it in numerous prescription books and pharmaceutical encyclopaedias, even until the middle of the twentieth century,[93] and several pharmaceutical companies – amongst them Parke, Davis & Co., Fairchild Bros. & Foster, W. H. Schieffelin & Co. and Eli Lilly – recognized the commercial potential of Warburg's Tincture and related preparations (Figure 7).

We end with a reflection about Carl Warburg himself. Was he a benefactor of mankind? An unfortunate hero, who could not reap the rewards of the work he devoted his whole life to? Or was he just a fraudulent impostor, a tragic kind of one-trick pony, manically fixated on that one idea? Based upon the scattered fragments of surviving evidence relating to Warburg's eventful life, those judging him will find elements of both fraud and tragedy.

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Endnotes and References

1. Middelman, RF. Schomburg, Moritz Richard. In Nairn, B. (ed.) *Australian Dictionary of Biography*. Volume 6. Melbourne: Melbourne University Press, 1976. Available at http://adb.anu.edu.au/biography/schomburgk-moritz-richard-4543. Accessed 21 March 2020.

2. The case report as given by the patient himself appears in Schomburgk, R. and Roth, W. (translation). *Travels in British Guiana, 1840-1844*. Volume 1. Georgetown: Daily Chronicle, 1922: 58-59.

3. When the British took over the former Dutch – later French – settlement on the east bank of the Demerara River estuary in 1812 it was re-named Georgetown. Today the city is the capital of the Republic of Guyana, which achieved independence from the United Kingdom in 1966.

4. Schomburgk, R. and Roth, W. (Note 2) 1922: 58.

5. Urban, I. (ed.) *Symbolae antillanae seu fundamenta flora indiae occidentalis.* Volume 3. London: Williams & Norgate, 1902/1903: 121-123.

6. Schomburgk, R. and Roth, W. (Note 2) 1922: 58.

7. Schomburgk, R. and Roth, W. (Note 2) 1922: 59.

8. Hamlin, C. *More than hot. A short history of fever.* Baltimore: Johns Hopkins University Press, 2014.

9. For example, the 'lignum febrium' in Torti, F. *Therapeutice specialis ad febres periodicas perniciosas*. Modena: Bartolomeo Soliani, 1712.

10. Anon. New remedy for intermittent fever. *London Medical and Surgical Journal.* 1836: 8; 128.

11. Between 1833 and 1836 Adam de Bauve published eight reports on his travels through Guyana. See *Bibliographie botanique de Guyane.* https://herbier.unistra.fr/flore-et-vegetation-doutre-mer/flore-et-vegetation-de-guyane/bibliographie-botanique-de-guyane/. Accessed 21 March 2020.

12. Anon. (Note 10) 1836: 128.

13. Anon. *Pharmakologische Notizen über die Wirkung und den Gebrauch der Dr. Warburg'schen Vegetabilischen Fiebertinctur*. Wien: 1846: 6. Also Warburg, C. *Specific for fever, now first introduced into Europe*. London: 1839.

14. *British Medical Journal*. 1857: 4-1(5); 99.

15. Moore, N. Halliday, Andrew. In Stephen, L. and Lee, S. (eds). *Dictionary of National Biography*. Volume 24, London: Smith, Elder, & Co, 1890: 110-111.

16. Halliday, A. On the bebeeru tree of British Guiana and sulphate of bebeerine, the former a substitute for cinchona, the latter for sulphate of quinine. *The Edinburgh Medical and Surgical Journal*. 1835: 44; 546-548.

17. The first description of the species as *Nectandra rodici* was given by Richard Schomburgk, see *The London Journal of Botany*. 1844: 3; 624-629. The timber of the demerara greenheart, now termed *Chlorocardium rodiei Rohwer et al.*, is extremely water resistant and hence used for ships and hydraulic engineering. In the 1960s the 'alkaloid Bebeerine' proved to be a complex mixture of bis-benzylisoquinolines like Rodiasin, which show some pharmacological activity and contribute to resistance against aquatic organisms.

18. *The Medico-Chirurgical Review*. 1839: 39; 49-53.

19. Halliday, A. *On the Sickness and Mortality in the West Indies*. London: Parker, 1839: 33 and 20.

20. Halliday, A. (Note 19) 1839: 21-23.

21. *Medical Times*. 1851: 24; 416.

22. Tedder, HR. John William Parker. In Stephen, L. and Lee, S. (Note 15) 1895: 43; 251-252.

23. The dual role of printers and publishers in marketing and distribution of patent medicines is discussed more in depth by Mackintosh, A. *The patent medicine industry in Georgian England. Constructing the market by the power of print*. Cham: Palgrave Macmillan/Springer, 2018.

24. Warburg, C. (Note 13) 1839: 1.

25. A puncheon was a barrel normally used for carrying wine or rum and had a capacity of 70 gallons or about 320 litres.

26. *Medical Times*. 1851: 24; 411.

27. *Medical Times*. 1851: 24; 416-417.

28. *The London Gazette*. 1841: 17 December; 3263.

29. Dupuis, F. *Dr Warburg's Vegetabilische Fieber-Tropfen in ihrer pharmakodynamischen Wirkung und Bedeutung beobachtet und dargestellt*. Mainz: author's edition, 1843.

30. Anon. Gar keine Krankheiten mehr! *Didaskalia. Blätter für Geist Gemüth und Publizität.* 1843: 27 December (356); 2-3. When Carl Warburg (born 13 March 1804 in Mainz) arrived in England for the first time on 9 November 1826 his profession was noted as 'clerk'. In the Census of 1851 Carl Warburg's profession is given as 'M. D. of Heidelberg, not practising'. But in fact this was a Mainz-born Christoph Warburg, possibly Carl's brother Franz Christoph (1809-1869), who enrolled for medicine at the University of Heidelberg in July 1828 at the age of 19 years.

31. Anon. *Hospital reports and other official documents relative to the trials of Warburg's Fever Tincture* [etc]. London: Parker, Furnivall and Parker, 1849: 15-16.

32. This step was considered as 'a very extraordinary proceeding on the part of the Austrian Government', even in foreign countries. See *The Pharmaceutical Journal and Transactions*. 1850: 9; 4-6.

33. Winckler, FL. Chemische Analyse der vegetabilischen Fiebertropfen des Dr. Warburg. *Jahrbuch für practische Pharmacie*. 1844: 7; 137-146 and 273-278.

34. Buchner, JA. Dr. Warburg's vegetabilische Fiebertropfen. *Repertorium für die Pharmacie*. 1844: 85; 327-350.

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35. *Gazzetta medica di Milano*. 14 June 1845: 4; 212.

36. Its contents included Angelica, Imperatoria, Serpentaria virginica, Zedoaria, Juniperus, Myrrha, Crocus, the *Theriac of Andromachus* and camphora and exhibited irritant, diuretic, diaphoretic and antispasmodic effects. See Anon. *Pharmacopoea universalis oder übersichtliche Zusammenstellung der Pharmacopöen* [etc]. Volume 1. Weimar: Großh. Sächs. pr. Landes-Industrie-Comptoir, 1832: 213-214.

37. That preparation also contained aloes, myrrh and crocus. Two of the numerous variants known were said to trace back to Paracelsus and Boerhaave. See Strumpf, FL. *Allgemeine Pharmacopöe*. Leipzig: Winter, 1861: 126-127.

38. Lettera del dottor Carlo Chiolini al chiarissimo signor cav. Dott. Giambattista Fantonetti sul liquore febbrifugo di Warburg. *Annali universali di medicina*. 1845: 115; 518-530.

39. Anon. (Note 13) 1846: 9.

40. *Wiener Zeitung*. 10 December 1846: 2771.

41. *Zeitschrift der k. k. Gesellschaft der Aerzte zu Wien*. 1847: 4(2); XII–XIV.

42. *Österreichische medicinische Wochenschrift*. 25 September 1847: 39; 1254-1255.

43. Prašelj, N. and Slezak, P. Knolz (Knolc, Knotz), Joseph Johann. In *Österreichisches Biographisches Lexikon*. Volume 4. Wien: Österreichische Akademie der Wissenschaften, 1966: 1.

44. Knolz, JJ. *Systematische Einteilung der Fieber, als Leitfaden zur Diagnostik derselben am Krankenbett*. Salzburg: Duyle, 1827.

45. *Österreichische Medizinische Wochenschrift*. 1847: 7; 17-30.

46. The above-mentioned pamphlet gives eight indications, and appeals to medical creativity by stating: 'However, this remedy is also likely to be helpful in many other, both acute and chronic conditions'. See Anon. (Note 13) 1846: 16-19.

47. *Österreichische Medizinische Wochenschrift*. 1847: 7; 1419-1425.

48. Approximately equivalent to 44 € or £37. See https://www.eurologisch.at/docroot/waehrungsrechner/#/. Accessed 21 March 2020.

49. *Österreichische Zeitschrift für Pharmacie*. 1848: 2; 258.

50. *Österreichische Zeitschrift für Pharmacie*. 1849: 3; 65-74.

51. *Wiener Zeitung*. 2 September 1848: 239; 554.

52. Anon. (Note 30) 1849: V-VIII.

53. *Amtsblatt zur Wiener Zeitung*. 10 July 1849: 162; 56.

54. Anon. (Note 30) 1849: V.

55. Anon. (Note 30) 1849.

56. *Medical Times*. 1851: 23(52); 700-702.

57. Schinzl, A. Mensdorff-Pouilly, Emanuel Graf von. In Historische Kommission (ed.) *Allgemeine Deutsche Biographie*. Volume 21. Leipzig: Duncker und Humblot, 1885: 366-370.

58. Munk, W. *The Roll of the Royal College of Physicians of London*. Volume 3. London: The College, 1878: 222.

59. Evans, A. Benjamin Guy Babington: Founding President of the London Epidemiological Society. *International Journal of Epidemiology*. 2001: 30; 226-230.

60. Anon. (Note 30) 1849: 16-17 and 19-20.

61. *Medical Times*. 1851: 23(52); 702.

62. Mackintosh, A. (Note 23) 2018: 268-271.

63. *Medical Times*. 1851: 23(52); 702.

64. Hunt, R. Davy, John (1790-1868). In Stephen, L. (ed.) *Dictionary of National Biography*. Volume 14. New York: Macmillan and Co., 1888: 195-196.

65. *Medical Journal*. 1851: 24(61); 239.

66. *Medical Times*. 1851: 24(53); 23-24.

67. *Medical Times*. 1851: 24(53); 23.

68. 'The object of trade is money; the object of a Profession, to advance the welfare of humanity, spiritually, morally, or corporally'. *Medical Times*. 1851: 24(53); 23.

69. Anon. *Warburg Tincture. Statement proving by numerous official documents its remarkable curative power in fevers more especially in those of tropical climates*. [etc]. London: Trübner and Co, 1870.

70. Anon. (Note 68) 1870: 4.

71. Blair, JSG. William Campbell Maclean. *Journal of the Royal Army Medical Corps*. 2005: 151(1); 49-50.

72. Maclean, WC. Malarial fevers. In Reynolds, JR. (ed.) *A System of Medicine*. Volume 1. London: Macmillan, 1866: 51-81.

73. Burkhardt, F. (ed.) *The Correspondence of Charles Darwin*. Volume 24, Cambridge: Cambridge University Press, 2016: 8.

74. Maclean, WC. On the true composition and therapeutic value of Warburg´s tincture. *Lancet*. 13 November 1875: 716-718.

75. Munk, W. *The Roll of the Royal College of Physicians of London*. Volume 2, London: The College, 1878: 256-257.

76. Grant, W. *Observations on the Nature and Cure of Fevers*. Volume 2. London: Cadell, 1772: 162-163.

77. Brown, T.E.B. Confectio Damocratis, *The Indian Medical Gazette,* 1 March 1877: 12; 66. Brown confirmed that Confectio Damocratis, or Damocratis's Confection, was a synonym for Mithridatium, and reproduced the formula for it given in the *London Pharmacopoeia* of 1746.

78. *The Indian Medical Gazette*. 1 August 1876: 11; 221.

79. *British Medical Journal*. 22 September 1878: 925; 444.

80. *Medical Record*. 1 August 1885: 28; 127.

81. Wootton, AC. *Chronicles of Pharmacy*. Volume 2. London: Macmillan, 1910: 206-208.

82. *Canada Lancet*. 1885: 18; 100.

83. *Canada Lancet*. 1885: 18; 100.

84. In an advertisement, Schieffelin & Co. announce that 'our Warburg's Tincture is prepared in accordance with the original formula, except that Confection of Theriac Ph. G. is substituted for Confection Damocratis – an unofficial and impracticable preparation, some ingredients of which are nowhere obtainable'. *American Journal of Pharmacy*. 1886: 58(8); 1 (front matter).

85. Waller, JH. *Gordon of Khartoum. The Saga of a Victorian Hero*. New York: Atheneum, 1988.

86. Junker, W. and Keane, AH. (translation). *Travels in Africa during the years 1875-1878*. Volume 1. London: Chapman and Hall, 1890: 231.

87. *The Medical Times and Gazette*. 24 June 1861: 574; 684.

88. Pagel, J. (ed). *Biographisches Lexikon hervorragender Ärzte des neunzehnten Jahrhunderts*. Berlin: Urban & Schwarzenberg, 1901: 1492-1493.

89. Schellong, O. Bemerkungen zur medicamentösen Therapie des Malariafiebers. *Therapeutische Monatshefte*. 1889: 3; 540-542.

90. See https://en.wikipedia.org/wiki/John_Kieran. Accessed 21 March 2020.

91. As Kieran explains, pools on the construction site of the Jerome Park Reservoir, built in 1906 as part of the city's water supply, provided ideal conditions for the Anopheles mosquito.

92. Kieran, J. *A Natural History of New York City*. Boston: Hughton Mifflin, 1959: 104.

93. For example, a 'Tinctura antiperiodica sine/cum Aloe. Warburg´s Tincture' was still monographed in Hagers *Handbuch der pharmazeutischen Praxis* of 1938. An ammoniated tincture of quinine, as a descendent of Warburg's Tincture last appeared in the *British Pharmaceutical Codex* of 1963.

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ARTICLE

An initial study on a poison antidote powder from a late seventeenth century Italian medicine chest

Andrew Hardy

Abstract
Initial studies, both chemical and historical, have been carried out on a 'powder against poisons' retrieved from a late seventeenth century Italian medicine chest. The chest was given to John Clerk of Penicuik when he left the Florentine court of the Grand Duke of Tuscany in December 1698. In this article the various poison antidotes known at that time are discussed in general terms, before considering specific recipes that could have been used in the Grand Duke's pharmacy, where the powder was made. Three such recipes were found in two primary sources; these have been translated and are listed here. Initial studies show that the sample is very probably a poly-herbal remedy, perhaps containing as many as ten plant species.

Introduction

The elite of Europe in the Renaissance and Early Modern periods (roughly c.1350 to c.1650 and c.1450 to c.1750 respectively) well knew the dangers of poisoning. Hence the need for food and wine tasters, strict laws on the possession of poisons, and a keen interest in their antidotes. Poisoning could arise from eating contaminated food or drink, being bitten by a poisonous snake or insect, and from an act of deliberate poisoning. Antidotes were often herbal, but could also be of animal or mineral origin.[1]

There were hundreds of such antidotes known in these time periods. Often the ones most sought after, by those who could afford them, were those made of exotic materials, and often made according to ancient recipes. Also, some antidotes became attached to a particular person, usually a high-ranking member of the ruling elite. They would have ordered and overseen the making of the antidote, and even sometimes been directly involved in its manufacture. Dozens of German princes had a 'powder against (all) poisons' associated with their names. Some of these 'named' antidotes were tested in 'poison trials', where the subjects were dogs or condemned-to-death criminals (see later in the Discussion).[2] A few antidote examples will now be briefly mentioned.

Absorbent clay minerals were present in the *Terra Sigillata* (literally 'sealed earth' – that is some moist clay that had been stamped with an image of a seal) tablets used as poison antidotes. They were crushed and taken in wine as soon as possible after ingesting a poison. A successful (human) 'poison trial' was done on one such antidote in Langenburg (Germany) in 1581.[3, 4]

An animal bone or part, especially if the animal was very rare or mythical, was sometimes fashioned into a drinking vessel in the belief that any poison in liquid it contained would be absorbed or destroyed. Examples were bezoar stones and a unicorn's horn. A bezoar stone is a calculus (accretion stone) from an animal's (such as a goat) stomach or intestine, and a unicorn's horn in reality was often a horn of a rhinoceros or the tusk of a narwhal.[5, 6, 7]

There were many herbal poison antidotes known in our time periods (see above, overall c. 1350 to c. 1750). Some of them were common, and so accessible to all, herbs such as: sage, gentian, veronica and perforata. The German botanist, physician and Lutheran priest Hieronymus Bock (1498 – 1554) listed almost 50 herbs that could 'drive out poisons'. The 'expelling of poisons' would result from using herbs that were emetics (i.e. causing vomiting; one example being European squill) or laxatives/purgatives (such as senna, which was used by the Pharaohs of ancient Egypt, but where the general populace used castor oil and beer). Also, the English herbalist, physician and astrologer Nicholas Culpeper (1616-1654) listed about 40 herbs that could be used as poison antidotes.[8, 9, 10]

All these herbs could be used individually (i.e. as 'simples') or be added together (usually not more than 10 ingredients) for added effect, and so were then thought to act against many different poisons. There were also a few well-known antidotes – often very expensive and difficult and time consuming to make – which were said to work against all poisons, and were often only made under license. These contained tens of herbal ingredients.

One such antidote was 'Theriac' (sometimes known as *Theriaca Andromachus*), which often contained crushed viper flesh, opium, various oils and resins, and between 60 and 80 herbs. The ingredients would be slowly pulverized and then mixed with honey to make an electuary. The final product could be the consistency of syrup (i.e. using a large amount of honey) or as a thick paste to give pills or lozenges (i.e. using a small amount of honey). Such antidotes often evolved over time into 'cure-alls'.[11]

The Grand Dukes of Tuscany – who reigned from 1569 (the first was Cosimo I, 1519-1574) to 1737 (the last was Gian Gastone, 1671-1737), although the latter's sister (Anna Maria Louisa, 1667-1743) reigned as Grand Duchess from 1737 to 1743 – as the last of the

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senior branch of the de Medici family, all took an interest in poisons and their antidotes.[12] Further mention of this interest, and the availability of directly relevant antidote recipes, is made in the Discussion below.

Figure 1. *John Clerk of Penicuik as a student in Holland of c.1695? Pencil drawing by William van Mieris. (Source: © Sir Robert Clerk of Penicuik Bt)*

Figure 2. *Cosimo III de Medici, Grand Duke of Tuscany. (Source: Wikimedia Commons)*

Sample, chest, people and provenance

At the end of the seventeenth century, John Clerk of Penicuik (1676-1755), who became the second baronet Penicuik in 1722 (Figure 1), attended the Florentine court of Cosimo III (1642-1723), who reigned as Grand Duke of Tuscany from 1670 (Figure 2). When he left the court in December 1698, at the age of 22, he was given several gifts by the Grand Duke.

One of these was later described as 'a Box of chymical medicines' (Figure 3) by its new owner. The figure shows both drawers of the opened medicine chest.[13, 14] Samples were removed from several of the parchment-covered glass containers for later chemical analysis. One of them was labeled 'Polvere contri di veleni' ('Powder against poisons') and is the subject of the current study. Figure 4 shows its container and associated 'dosage leaflet'. The sample is a brown granulated powder with no obvious odour.

Figure 3. *The opened medicine chest. (Source: © Sir Robert Clerk of Penicuik Bt)*

Figure 4. *Author's sample in a labelled covered glass container, and its 'dosage leaflet'. (Source: © Sir Robert Clerk of Penicuik Bt)*

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Analytical methods and results

The analytical techniques used were: LVSEM (Low Vacuum Scanning Electron Microscopy), XRPD (X-Ray Powder Diffraction) and two TIC GC-MS (Total Ion Chromatogram Gas Chromatography – Mass Spectrometry) analyses. The first technique gives a quantitative summary of the elements present down to and including an atomic number of 6 (i.e. carbon), the second gives semi-quantitative data on the crystalline compounds present, and the third gives data on the organic compounds present.[15]

The analytical results for the sample are given below: first the LVSEM results in decreasing order of elemental weight percent (with the elements in brackets being less than 1% each), then summaries of the XRPD and TIC GC-MS results.

LVSEM: C, O, Ca, K (Si, Al, Fe, S, P, Mg).

XRPD: Two crystalline compounds were identified – Quartz ($SiO2$) and Calcium oxalate mono-hydrate ($CaC2O4.H2O$). Each is estimated to have a percentage presence between 5 and 10%. There is also a large broad peak in the data, indicating the presence of amorphous compounds.

TIC GC-MS: A): Using a polar solvent (methanol), only five molecules could definitively be identified from the thirteen peaks obtained. Two peaks gave a combination of two molecules each; where one gave an unknown and iso-patchoulane (to a total relative amount of 6.1%), and the other gave an unidentified sesquiterpene and (possibly) patchouli alcohol (to a total of 4.1%). The other four molecules identified were: iso-alantolactone (1.1%), 9-Octadecenamide (6.7%), 4-(2,3-Dihydroxy-3-methylbutoxy) furo(3,2-g)chromen-7-one (23.4%), and Sitosterol (9.9%).

B): Using a non-polar solvent (hexane), only four molecules could definitively be identified: Eicosane (0.8%), isopropyl palmitate (1.0%), 4,14-Dimethyl-9,19-cyclocholestan-3-one (10.0%) and Perhydro-1-(1,5-dimethylhexyl)-3a,6,6,12a-tetramethyl-cyclopenta[a]cyclopropa[e]phen-anthren-7-one (11.9%). Also, four unidentified aliphatic hydrocarbons were listed (to a total of about 2.6%), and six molecules listed as being 'Siloxane related' (to a total of about 6.9%).

Medicines, the Medicis and the Royal Foundry

A translation of the 'dosage leaflet' for the sample, shown in Figure 4, is given in Box 1. The words in square brackets have been added by the author.

It should be noted that a drachm is slightly less than four grams, and the 'Oil against Poisons' is another poison antidote found in the medicine chest.[16] The 'Foundry' mentioned above is the literal translation of the Italian word 'fonderia'; more information on the various ones ('fonderie') set up by the Medici, and what was done in them, is summarized below.

Before the Florentine de Medici family became Grand Dukes of Tuscany they already had an interest in various pharmaceutical processes, and had set up many apothecary workshops and laboratories. The first Grand Duke (Cosimo I, reigned 1569-1574) took over the pre-existing 'Fonderia di Palazzo Vecchio' (in Florence) and it became the 'Fonderia Reale' ('Royal Foundry').

He also created a workshop in the Boboli Gardens, where kilns were installed. His eldest son Francesco I

Box 1. *Translation of the dosage leaflet provided with the powder*

Powder against poisons from the Foundry of the Serene Grand Duke of Tuscany. It works against any strong poison ingested through the mouth giving the possibility of eliminating the poisoned food by vomiting and protecting the heart from ill effects. And to find out if one has taken some poison, the patient will appear [to be] losing his strengths, losing color in his face, cold and hot sweats, heavy vomiting, intolerable pain and heat in the stomach, vertigo, difficult breathing and similar symptoms which are caused by said poisons.
However, very quickly take two drams of the powder in a generous quantity of wine, so that it can be drunk easily, applying the "Oil against Poisons" on the heart, on the nostrils [?] and according to the recipe of the "Oil against Poisons". Furthermore, it will be possible to adjust the quantity of the powder according to age, complexion, according to the doctor's own judgment.
However, if they were corrosive poisons, it would be possible to use fat broths, common oil, lard, butter, milk, barley water, to defend from the corrosion the parts where the damage brought by the heat of the poison has not yet left a sign. And if it was recognized the need to take again [the medicine], and not having anything handy, it can be taken with common water with great efficacy, fast [is?] this powder against poisons [and] only from the Royal Foundry of the Serene Grand Duke and not from other places, this being a particular secret of S.A.S.* in his Foundry.

* S.A.S. is 'Sua Altezza Serenissima' ('His Most Serene Highness')

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(reigned 1574-1587) moved the main Royal Foundry to the Palazzo Uffizi, and also set up another Foundry at the Casino di San Marco. This house passed to his illegitimate son Don Antonio de Medici (1576-1621), who from 1597 lived there, and where he also set up his own Foundry. The Royal Foundry was moved in the last years of the reign of Cosimo III (reigned 1670-1723) to the Palazzo Pitti.[17]

Apart from furnaces for smelting and forging metals, there were added to the Royal Foundry facilities for studying and making medicines, porcelain, cabinets and chests, confectionery, clocks and other mechanical devices, the study and cutting of various gemstones and also facilities for the printing of the various 'dosage leaflets'.

However, from the time of the fourth Grand Duke, Cosimo II (reigned 1610-1621) and also under his successor (Ferdinand II, reigned 1621-1670), its budget, facilities and hence output was increasingly reduced. During at least the last fifteen years of the reign of Cosimo III (i.e. from c. 1708), when in the Pitti Palace, it was apparently acting mainly as a pharmacy, albeit a large one, with eleven rooms.[18, 19]

Historical data on the availability of herbal poison antidote recipes

Only a few documents have been found, fully translated and commented on in the published literature, that give information on the medical recipes used in the various fonderie previously mentioned. One is a short manuscript of sixteen leaves, dated 1556, that gives information on what was done in the early fonderia ('experiments and sure things by the hand of the duke of Florence or in his presence' – where this refers to Cosimo de Medici, who in 1569 became the first Grand Duke of Tuscany, as Cosimo I). It is mainly concerned with distillation experiments, but does also contain five recipes. Unfortunately, none are for powder poison antidotes.[20]

Also, several manuscripts are known which are linked to Don Antonio de Medici and the fonderie (i.e. his and his father's before him) at the Casino di San Marco. One, printed at the Casino in 1604 by Don Antonio, is 140 pages in length and is entirely devoted to chemical medical recipes. However, to date no recipes from it that are powder antidotes, have been published in English.[21]

Recently a manuscript has been found that is linked to Anna Maria Louisa de Medici, Grand Duchess of Tuscany from 1737 to her death in 1743. It contains various culinary, alchemical and medical recipes, where only some of them have so far been posted online and these do not include powder antidotes.[22] It is hoped that relevant detailed recipes from these two manuscripts will be published in the near future and so can be included in a later paper on further studies of samples from this medicine chest.

So, what were the sources of the medical recipes used in the Royal Foundry? There may be more manuscripts that have yet to be found, translated and published (see above). Did these manuscripts incorporate already known recipes, and were they perhaps modified before use? Or were various known and published recipe sources used directly? Or was there even either an official or unofficial collaboration with another fonderia (i.e. using their recipes), or similarly with a well-established pharmacy such as the 'L'officina Farmaceutica di Santa Maria Novella' in Florence?

One such known written source of recipes was Pietro Andrea Matthioli's (1501-1577) *Discorsi* ('Commentaries') on the *De Materia Medica* of Dioscorides (c.40-90 AD).[23] An extensive Table ('Tavola Delle Rimidi de Tutti i Morbi', or 'Table of the Remedies of all Diseases') is given after the end of his last book (number six) and index of the 1568 edition. A sub-section of the poisons Table ('Tavola Veleni') entitled 'For all the poisons' ('A tutti li veleni'), with a side-of-page notation saying 'Care for all poisons' ('cura di tutti li veleni'), lists almost 60 poison antidote recipes. Almost two-thirds of these are listed as 'Di Dioscoride' ('of Dioscorides') and one third 'Del Matthiolo' ('by Matthioli').

The most relevant of these, that is recipes that could have been used to make the current sample, are currently thought to be the two poly-herbal (i.e. more than three ingredients) recipes (and part of the 'Del Matthioli' list).[24] The translations into English of their ingredients are given below in the following way: first common name(s) and then (in brackets and italics) the scientific name – Genus, and where known, the species. If there is uncertainty then a ? is used.

Recipe 1: Roots of .... Stinking? Iris/Florentine Iris? (*Iris*); Master-wort (*Peucedanum ostruthium*); Horse-heal/Elf-lock/Elecampane (*Inula helenium*); White Dittany (*Dictamnus albus*); Swallow-wort (*Vincetoxicum hirundinaria*); Snake-weed/Snake-root (*Bistoria officinalis*?); and Tormentilla (*Potentilla erecta*). The only additional information given is that it is (to be taken as) 'a drink'. This is assumed to mean that the seven roots are powdered, mixed thoroughly and then taken as required with water or wine.

Recipe 2: Rapeseed (*Brassica napus*); White Turmeric (*Curcuma zedoaria*); Master-wort (*Peucedanum ostruthium*); Swallow-wort (*Vincetoxicum hirundinaria*); Water Germander (*Teucrium scordium*); Blessed Thistle (*Cnicus benedictus*); St. John's wort (*Hypericum perforatum*); Snake-weed/Snake-root (*Bistoria officinalis*?); Tor-

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mentilla (*Potentilla erecta*); and Common or Garden Angelica (*Angelica archangelica*). The only additional information given is that it (can be taken) 'in any way'. Again, it is assumed that each ingredient (their roots?) is powdered and then all ten thoroughly mixed. The mixture is then taken as required in water or wine or with soup or even with food.

No amounts for each ingredient are given in either recipe, and similarly for the dosages.

The recipes of Stefano Rosselli

Another possible source of medical recipes used in the Royal Foundry is 'Mes secrets a Florence au temps du Medicis 1593' ('My secrets in Florence at the time of the Medici 1593'), by Stefano Francesco Di Romolo Rosselli (1523-1597) the Florentine apothecary.[25] Much more detail is given, such as amounts of each ingredient and detailed instructions for making the recipes. Also, various dosages are given. There are two recipes for 'powder against poisons', No. 7 and No. 41 (in both the original Old Italian and translated into modern-day French). The full translation into English is given in Box 2 only for recipe No. 41, as it gives information on a 'poison trial' (see later).[26]

Note that here an ounce is taken to be equivalent to 30.16 grams and a drachm to 3.77 grams (i.e. one eighth of an ounce).[27] As before, words in square brackets have been added by the author, and where uncertainty exists a ? has been inserted. Ualenbrosa refers to Vallombrosa Abbey, a Benedictine abbey about 30 kilometers south east of Florence, and Master Baccio Baldini (d.1589) was a physician to Grand Duke Cosimo I.

The date of the 'poison trial' mentioned in the above recipe is uncertain. It possibly refers to the 1566 trial ordered by Duke Cosimo (then Duke of Florence) to test Matthioli's 'powder against all poisons' (where a so-labeled recipe could not be found in his 'Discorsi' of 1568). A convict was given a mortal dose of arsenic followed by the powder.[28] An earlier trial on a famous poison antidote powder linked to Archduke Ferdinand II of Tyrol in Austria took place at the Imperial Court of Prague in December 1561. On this occasion the poison used on the convict was the deadly herb napellus, but the poison antidote powder failed and the convict died. However, this same powder had earlier been used successfully on a convict who had taken arsenic.[29]

Thus, this earlier trial could be the one referred to in Rosselli's recipe. It is sometimes difficult to determine exactly which trial is being referred to as they were being done increasingly, at various palaces and courts in sixteenth century Europe. Also, it is difficult to know the exact ingredients of one of these powder antidotes, as a new 'owner' may have changed a previous recipe. A comparison of the three powder poison antidote recipes is presented in the discussion.

Box 2. *Translation of instructions for preparation of Recipe No. 41*

Another Powder against poisons, and corrosive [agents]. Originated from the Archduke of Austria and given to Grand Duke Francesco Medici. It was tested on a prisoner who was about to die yet lived. We, Master Baccio Baldini and myself, were there.

Take: half an ounce of Valerian minor root (Duke Francesco used to take five ounces);
An ounce of swallow-wort root;
An ounce of [common?] nettle root;
Two ounces of domestic/garden/common angelica;
Two ounces of marsh-mallow;
Four ounces of wild angelica, that is our domestic species with the same properties as the Jalap;
An ounce and a half of common polypody;
An ounce and ten drachms of thymelaea roots, their barks (the Duke Francesco used to take two ounces of thymelaea from the meadows of Ualenbrosa, which is not the true thymelaea).

You will collect all these roots in the month of either August, September or October, clean them, and from all of them take the bark and reduce [mince?] them to small pieces.
You will put them in a well-sealed glass vase, with good capacity, and cover them with a very strong vinegar two fingers above the roots. Then close this vase with a linen cloth covered in flour and egg white, so that it cannot breathe; let it infuse [brew/steep?] for ten hours.
Then, place it on a low heat for one hour, then decant the vinegar and keep it aside for making syrup and place the roots to dry on a table for half a day.
Once they are dry, add twenty-five berries of the herb-Paris, pound everything with care, and preserve in a well-sealed glass vase; and you shall give to a strong man one and a half drachmas at the time with white wine, and to a weak man two drachmas; to a young man one drachma in the same way as above.
This [powder] was experimented by administering two drachmas of crystalline arsenic and within half an hour [the prisoner] had all the symptoms of impending death before administering him the powder, and he was [then] symptom free.

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Examples of published analyses of old plant residues

The examples given below cover the identification of one or more plant species in old residues, and also includes the identification of plant extracts (i.e. oils and/or resins).

Example 1: Recently a chemical analysis, using the GC-MS technique, was done on the organic substances found in three jars from Abydos (Egypt). They were dated to the Early Dynastic period (3100 – 2700 BCE). Two conifer essential oils were identified: one from real/true cedar and it was suggested that the other was from juniper or cypress. The authors also suggested that these oils had been made by steam distillation of a mixture of plant parts from the two conifers, and that they were used as cosmetics or medicines rather than in an early form of embalming/mummification.[30]

Example 2: The contents of an Islamic ceramic pot, found in Zaragoza (Spain) and dated to the eleventh century AD, was studied using several analytical techniques. These were: optical microscopy, SEM (with x-ray energy-dispersive spectrometry), XRPD and pyrolysis-GC-MS. Overall, the following substances were identified: orpiment (the yellow form of Arsenic sulphide, $As2S3$), a fig, three grape or raisin seeds and a small amount of gypsum ($CaSO4.2H2O$). This mixture could have been used as a (yellow) coloring material, but could also have been used as a medicine.[31]

Example 3: A medicinal plaster was found on the left clavicle of a (female) skeleton excavated at a site in Szarbia, Malopolska province, southern Poland. The grave was dated to the early Bronze Age, that is the late phase of the Mierzanowice culture (c. 1750 to 1600 B.C.). The plaster was black in color and densely embedded with silver-coloured nutlets. An archaeometric analysis of the plaster showed that it was made of wood tar, and an archaeobotanical analysis showed that the nutlets belonged to the common gromwell (*Lithospermum officinale*). Whilst both have pharmacological properties (such as for wound healing), it is also possible that the nutlets were present as a sympathetic medical agent and/or as magical additives.[32]

Discussion of the chemical and historical data

The existence of crystalline quartz (silicon dioxide) and calcium oxalate mono-hydrate in this sample indicates the presence of plant material. Both are found in various plant parts (such as roots, stems and leaves), and both are involved in the plant's bio-mineralization processes.[33] Also, sitosterol, found in the TIC-GC data from the polar solvent's extract, is a 'molecular biomarker' for the presence of plant material, such as the existence of a plant oil.[34]

Other molecules identified from the polar extract each give several possibilities for a plant source being present. For example, one of several possible sources for iso-alantolactone is *Inula helenium* (Elecampane); and the 'possibly patchouli alcohol' occurs in patchouli oil (*Pogostemon* species), *Valeriana* species, and other plant species. The remaining molecules, and those found in the non-polar extract, are either very common (e.g. the isopropyl palmitate), common (as above) or are contaminants (e.g. the siloxanes).[35]

In the three translated recipes given previously there is only one common ingredient: Swallow-wort. Between 'Recipe 2' (Matthioli) and 'Recipe No. 41' (Rosselli) there is one common ingredient: common garden Angelica. Also, there are four common ingredients between the two Matthioli recipes: Swallow-wort, Masterwort, Snake-weed and Tormentilla.

As expected, a large number of the recipes' ingredients are listed – in a herbal of the mid-seventeenth century – as having medicinal properties associated with poison antidotes. In *Culpeper's Complete Herbal* of 1653 three ingredients are mentioned as emetics or purgatives; Thymelaea and Herb-Paris as emetics, and Common polypody as a mild purgative. Another two are listed as general poison antidotes (Master-wort and Blessed Thistle): and ten are mentioned for snake bites or insect stings; these are Tormentilla, Elecampane, Swallow-wort, Snake-weed, Water Germander, St. John's wort, Common Nettle, Marsh-mallow, Wild Angelica and Valerian minor.[36]

The current chemical analytical data does indicate that the powder is a herbal remedy, and as already mentioned (see Introduction) – given the sample's historical provenance – it is probably a poly-herbal remedy with up to ten plant ingredients. However, we now need to consider whether there is any evidence to suggest that one of the three poly-herbal recipes so far found and translated was used to make the present sample. Valerian minor (listed as an ingredient in Rosselli's No. 41 recipe) could be present in this sample, and similarly Elecampane (listed as an ingredient in Matthioli's 'Recipe 1') could also be present. However, each is just one of many possibilities for the species present given the molecule identified.

Thus, overall, the TIC-MS data is not comprehensive enough to draw any definitive conclusion about the herbs that are present in this sample, and from which recipe it was made. It is hoped that further analytical work, using GC-MS and/or LC-MS (Gas/Liquid Chromatography combined with Mass Spectroscopy), will reveal bio-marker molecules that can link a particular recipe of the past to the ingredients of the present 'powder against poisons'.

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In addition, we must consider to what extent if any one of the three translated recipes has a good 'link' to the Royal fonderia. If such a link can be established, then the recipe could perhaps have been used in making a powder such as this one. Matthioli's early 'Discorsi' of 1544 was well known to Cosimo I. His personal copy has many margin notes; but they are only present in the 'Di Dioscoride' sections.[37]

So, whilst Cosimo I probably did not use or pass on recipes from the 'Del Matthiolo' sections, later Grand Dukes could have used them. The Rosselli recipe 'No. 41' is said by him to have been given to Grand Duke Francesco (Cosimo I's eldest son, d.1587), who could have given it to the fonderia, and also perhaps to Rosselli. Another possibility, perhaps more likely, is that the recipe came to Rosselli via apothecary friends or colleagues who worked at the fonderia where it was being used.[38] So, all three recipes could have been known to or used by the fonderia of Cosimo III. Also, each could have been modified, perhaps more than once over the intervening hundred years or so, before being used.

In the sample's 'dosage leaflet' it is mentioned that it can act as an emetic (so 'expelling' the poison). Rosselli's recipe 'No. 41' contains two emetics (see above) – Thymelaea and Herb-Paris. Also, this recipe has had all its ingredients – *excluding* Herb-Paris – subjected to infusion or steeping by 'strong vinegar'. The remaining solid matter was dried and then mixed or crushed with a large number (25) of Herb-Paris berries. The reason for this method of preparation of the final powder was not given, but in effect it would be 'rich' in Herb-Paris, and so could reasonably be expected to act as an emetic – as mentioned in the 'dosage leaflet'. This may be a good enough reason to believe that this recipe was used to make the current sample; a tenuous one perhaps, but one that should be testable using future analytical data.

Conclusion

The initial data in this paper – both chemical and historical – on the 'powder against poisons' sample, strongly indicates that it is a poly-herbal remedy, perhaps containing as many as ten herbal ingredients. The three relevant (i.e. poly-herbal) recipes from two sixteenth century primary sources could all have been known to the pharmacy of Cosimo III in the late 1690s. Unfortunately, none of them can currently be definitively linked to the analysed sample. But the Rosselli recipe is currently – in the opinion of this author for the reasons given above – the more likely recipe to have been used in the fonderie of several Grand Dukes, and so in the making of this author's sample.

Poly-herbal remedies are very difficult to completely analyze. Each species present can contain tens of molecules. Additionally, such old remedies will have suffered a degree of molecular degradation over the centuries since they were first made. However, it is hoped that some species-specific molecular bio-markers in this sample have been preserved. Further analytical work could then generate data that leads to at least a few of the species present being identified. If these species all lead to one particular translated recipe, then this will give all the ingredients. This assumes that the recipe so identified had not been deliberately modified before the present sample was made.

Further relevant recipes will be searched for in various primary sources. These include a sixteenth or seventeenth century edition of the Florentine pharmacopoeia, and the Medici manuscripts previously mentioned. It should then be possible to combine new analytical data with historical data in the form of additional recipes in a later paper, and so definitely identify the recipe used to make the poison antidote powder that has been the subject of this paper.

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Endnotes and References

1. Jackson, WA. Antidotes. *TRENDS in Pharmacological Sciences.* 2002: 23(2); 96-98, and references therein.
2. Rankin, A. Gender, poison, and antidotes in early modern Europe. In: Grell, OP., Cunningham, A. and Arrizabalaga, J. (eds.), *It All Depends on the Dose: Poisons and Medicines in European History.* Abingdon, Hants: Routledge, 2018: 136-142 (Chapter 8), and references therein.

https://doi.org/10.24355/dbbs.084-202009111211-0

3. Jackson, WA. (Note 1) 2002: 96-98.

4. Hardy, A. and Rollinson, G. A chemical study of a 'Terra Sigillata' medicinal tablet from a late 17th century Italian medicine chest. *Pharmaceutical Historian.* 2016: 46(1); 2-7, and references therein.

5. Jackson, WA. (Note 1) 2002: 96-98.

6. Barker, S. Poisons and the Prince: Toxicology and Statecraft at the Medici Ducal Court. In: Wexler, P. (ed.), *Toxicology in the Middle Ages and Renaissance.* Amsterdam (The Netherlands), Elsevier, 2017: 77 (Chapter 7), and references therein.

7. Rankin, A. (Note 2) 2018: 136.

8. Mann, J. *Murder, Magic and Medicine.* Oxford (UK), Oxford University Press, 1992: 193-195.

9. Jackson, WA. (Note 1) 2002: 96-98.

10. Rankin, A. (Note 2) 2018: 139.

11. Blanchard, DL. Bartisch on Theriac. *Archives of Ophthalmology.* 2001: 119; 1360-1363, and references therein.

12. Barker, S. (Note 6) 2017: 71-82.

13. Clerk, Sir John (1676-1755). *Memoirs of the life of Sir John Clerk of Penicuik, baronet, baron of the Exchequer, extracted by himself from his own journals.* Available at http://archive.org/details/memoirslifesirj01clergoog (digitized by Google from a book in the collection of Harvard University, USA). Accessed 15 September 2018. The relevant pages, concerning his visit to Florence, are 7, 41 and 45.

14. Dingwall, H. and Worling, PM. 'A Box of chymical medicines': an Italian medicine chest presented to Sir John Clerk of Penicuik in 1698. *Journal of the Royal College of Physicians in Edinburgh.* 2012: 42; 361-367.

15. Ribechini, E., Modugno, F., Perez-Arantegui, J. et al. Discovering the composition of ancient cosmetics and remedies: analytical techniques and materials. *Analytical and Bioanalytical Chemistry.* 2011: 401; 1727-1738, and references therein.

16. Dingwall, H. and Worling, PM. (Note 14) 2012: 361-367.

17. Fornaciai, V. *'Toilette', Perfumes and Make-up at the Medici Court*. A publication by sillabe s.r.l., Livorno, Italy, 2007: 53-59.

18. Kieffer, F. The Laboratories of Art and Alchemy at the Uffizi Gallery in Renaissance Florence: Some Material Aspects. In: Dupre, S. (ed.) *Laboratories of Art: Alchemy and Art Technology from Antiquity to the 18th Century*. Basel, Switzerland: Springer International Publishing, 2014: 105-127.

19. Buchanan, A. *The Politics of Chocolate: Cosimo III's Secret Jasmine Chocolate Recipe.* Available at https://recipes.hypotheses.org/5454, posted online 7 April 2015 as part of the Recipes Project. Accessed 1 January 2019.

20. Bellorini, C. *The World of Plants in Renaissance Tuscany: Medicine and Botany.* Farnham, Surrey: Ashgate Publishing Limited, 2016: 28, 33-40, 165-6, 171-2, and references therein.

21. Bellorini, C. (Note 20) 2016: 28, 33-40, 165-6, 171-2, and references therein.

22. Buchanan, A. *History in High Heels: My Dissertation.* Available at https://historyinhighheels.com/2018/12/my-dissertation, posted online 13 December 2018. Accessed 3 January 2019.

23. Palmer, R. Medical botany in northern Italy in the Renaissance. *Journal of the Royal Society of Medicine*. 1985: 78; 149-157, and references therein.

24. Staub, PO., Casu, L. and Leonti, M. Back to the roots: A quantitative survey of herbal drugs in Dioscorides' *De Materia Medica* (ex. Matthioli, 1568). *Phytomedicine.* 2016; 23: 1043-1052; Supplement 9 of the Supplementary Materials is a pdf download of Matthioli's books five and six, the overall index and all the various Tables of recipes. The actual Tables' pages are not numbered; however, the pdf page number for the two poly-herbal recipes is 339.

25. Engle, P. *The Duke's Mouthwash*. Available at https://www.conciatore.org/2017/09/, posted online 22 September 2017. Accessed 7 November 2018.

26. Rosselli, S. F. di R. (original author) and de Zayas R. (transcription of the Old Italian and its translation into French). *Mes Secrets a Florence au temps des Medicis 1593*. Paris (France), Edition Jean-Michel Place, 1996: 146-7 (in French) and 234 (in Old Italian) for recipe 41.

27. In the literature the precise equivalence between apothecary and metric weights quoted can vary. I have used the values given in Rosselli's 1996 book (Note 26).

28. Barker, S. (Note 6) 2017: 79.

29. Rankin, A. On Anecdote and Antidotes: Poison Trials in Sixteenth Century Europe. *Bulletin of the History of Medicine*. 2017: 91; 274-302, and references therein.

30. Sarret, M., Adam, P., Schaeffer, P. et al. Organic substances from Egyptian jars of the Early Dynastic period (3,100-2,700 BCE): Mode of preparation, alteration processes and botanical (re)assessment of 'cedrium'. *Journal of Archaeological Science: Reports.* 2017: 14; 420-431.

31. Perez-Arantegui, J., Ribechini, E., Colombini, MP. et al. Characterization of an ancient 'chemical' preparation: pigments and drugs in medieval Islamic Spain. *Journal of Archaeological Science*. 2011: 38; 3350-3357.

32. Baczynska, B., Litynska-Zajac, M. Application of *Lithospermum officinale L*. in early Bronze Age Medicine. *Vegetation History and Archaeobotany.* 2005: 14; 77-80.

33. Bauer, P., Elbaum, R., and Weiss, IM. Calcium and silicon mineralization in land plants: Transport, structure and function. *Plant Science.* 2011: 180; 746-756.

34. Mayyas, AS. Organic residues in ancient pottery sherds from sites in Jordan. *Mediterranean Archaeology and Archaeometry*. 2018: 18(1); 61-75.

35. For determining the chemicals associated with various plant species the Dr. Duke's Phytochemical and Ethnobotanical Databases were used. Available at http://www.ars-grin.gov/duke/. Accessed 21 January 2019. See also the acknowledgments.

36. Culpeper, N. *Culpeper's Complete Herbal*. Originally published in 1653; (re-)printed and published by J. Gleave and Son, Deansgate, London in 1826 and finally by Magna Books, Leicester, UK in 1992: page 9 (Wild Angelica), 21 (Snake-weed), 70 (Water Germander), 77 (Herb-Paris/Herb True-Love), 80 (St. John's wort), 90 (Marsh-mallow and Master-wort), 106 (Common Nettle), 123 (Common Polypody), 167 (Thymelaea/Garden Spurge), 175/6 (Swallow-wort), 179 (Blessed Thistle), 185 (Tormentilla), 188 (Valerian minor), 232 (Elecampane).

37. Bellorini, C. (Note 20) 2016: 23-26.

38. Wheeler, J. *Medici anti-poison oil*. Available at http://renaissancesecrets.blogspot.com/, posted online 6 June 2013. Accessed 27 February 2019. Three of the names of friends or colleagues given here are those of Pietro Bertola, Paolo Banchelli and Niccolo Sisti.

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SHORT COMMUNICATION

Some notes on the *Gart der Gesundheit*, *1485*

Christopher J. Duffin

Abstract

The *Gart der Gesundheit*, the first herbal to be printed in German, straddles the medieval/early modern divide of medico-pharmaceutical literature. First published in 1485 by Peter Schöffer, a printing apprentice of Gutenberg's at Mainz, the text is believed to have been written by Frankfurt city physician Johann Wonnecke von Kaub at the behest of the Mainz official, Bernard von Breydenbach. Illustrated throughout with woodcuts produced by the Dutch artist, Erhard Reuwich, the text draws upon the works of numerous classical and medieval scholars. In many ways an innovative contribution to early pharmaceutical literature, the *Gart* was a very popular text which was the subject of numerous translations and pirated editions.

Introduction

Incunabulae are works printed in Europe before 1501. The term was first introduced by Adriaan de Jonghe (1511-1575), also known as Hadrianus Junius (Figure 1), who was a Dutch physician and humanist scholar.[1] Although incunabula literally means 'cradle' or 'swaddling clothes', de Jonghe was the first to apply it as 'inter prima artis [typographicae] incunabula' or 'the first infancy of printing'.[2] He arbitrarily chose the end of 1500 as the cut-off date for volumes to be qualified as incunabulae, a convention which has survived unchanged to the present day.

The printing technology of movable type developed in Germany in the 1450s and rapidly spread throughout Europe as artisans emigrated, and foreign apprentices returned home taking their new-found knowledge and skills with them. By 1500, printing was taking place at an estimated 282 town centres spread through eighteen European countries; around 30,000 incunabular editions have now been recognized.[3]

The printers of the *Gart der Gesundheit*

The *Gart der Gesundheit* belongs to what has been termed the *Mainzer-Kräuterbuch Inkunabulen* or the *Hortus Sanitatis* family of texts.[4] It is significant for several reasons. The volume acts as the temporal intermediate between medieval and early modern medico-pharmaceutical literature, as well as standing at the junction of the handwritten manuscript and printing traditions, and the Latin and vernacular means of communication.[5]

Figure 1. *Portrait of Adriaan de Jonghe (Hadrianus Junius; 1511-1575) by Theodor de Bry. (Source: The Wellcome Collection, CC BY)*

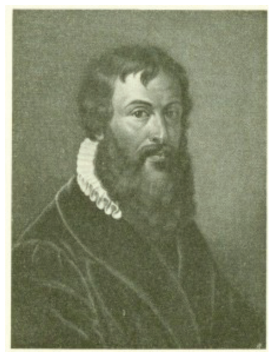

Figure 2. *Portrait of Peter Schöffer (c.1425-1503), the Mainz publisher of Gart der Gesundheit, 1485. (Source: Wikipedia, CCPD 1.0)*

Peter Schöffer (c.1425-1503), who has been described as 'a gifted artist, a highly competent craftsman, a shrewd business man, a citizen wise in the ways of the world, and a devout servant of God', was born in Gernsheim and studied at Mainz, before going on to Paris to study and work as a calligrapher and manuscript copyist (Figure 2).[6] Returning to Mainz, he was famously apprenticed to Johannes Gutenberg (c.1400-1468) during the production of the 42-line Bible (Vulgate), also known as the Gutenberg Bible or the Mazarin Bible, during the 1450s.

This monumental task represented the printing of the first major book using the system of mass-produced movable type, and was developed by Gutenberg himself. The print run, completed in 1455, is believed to

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have been a maximum of 180 copies, of which around 49 are known still to be extant. Gutenberg borrowed heavily for the venture; Johann Fust (c.1400-1466) loaned him 800 guilders in 1450 and a further, identical sum in 1452. Fust, a member of an ancient burgher family in the city, sued Gutenberg at the ecclesiastical court for the capital and interest on the loan when it became clear that the printer's debts were spiraling out of control. Schöffer – who was later to wed Fust's only daughter, Christina – testified against Gutenberg.

Fust won the case on 4 November 1455 and took over the Gutenberg business, with Peter Schöffer as Workshop Manager. Schöffer thrived in this position; he developed his own typographical fonts and published numerous highly acclaimed works, such as the Mainz Psalter in 1457 and the 48-line Bible in 1462. On Fust's death in 1466, Schöffer took over the business.

Early books from this time had their text blocks and design modelled on that of pre-existing manuscripts. Schöffer was instrumental in moving publishing away from this model, as the advantages and challenges of the new medium began to be appreciated. Amongst his innovations were the use of a regular printed title page, experiments with different page sizes, column arrangements and line numbers, and the use of woodcuts as illustrations.[7] Schöffer brought out the *Herbarius Moguntinus* – the first Herbal to be printed in Germany – in 1484.

Publication of the *Gart der Gesundheit*

A year later, in 1485, Schöffer published the *Gart der Gesundheit*, containing numerous woodcuts integrated into the text blocks (rather than being confined to facing pages, as in the *Herbarius Moguntinus*), which were characterized by a new typeface of semi-cursive design.[8] A marker of its success was the appearance, less than six months later on 22 August 1485, of a rival edition produced by Johann Schönsberger (c.1455-before 1521), 'that cheerful and indefatigable pirate', a printer in Augsburg, near Nuremberg.[9] This was a strategically located University town in Bavaria with close ties to the Holy Roman Empire and the famous patrician Fugger banking family, especially prominent during the fifteenth and sixteenth centuries. Part of a family inscribed into the salter's guild, Schönsberger was the stepson of Johann Bämler (died 1503), a leading publishing entrepreneur from whom he probably learned something of the trade.

In 1481, Schönsberger went into business with the goldsmith, Thomas Rüger (died 1482), and together they set up in 1481 a printing works in a distinguished part of the city (Katharinengasse in the Weinmarkt area of Augsburg). The publishing house was very active during the period 1481 to 1500, publishing around 260 works and, having established productive collaborative relations with other local, national and foreign dealers, dominated the market for vernacular German books over that period.[10] Copyright laws did not exist at the time, and he seemingly specialised in 'reprints' – effectively 'pirate' copies of works previously released by other publishing houses – which were often executed on poorer quality paper than the original. One such 'reprint' was his version of the *Gart der Gesundheit*, first published in August 1485, the same year as Schöffer's original.[11]

A further 'reprint' edition was published in 1485/1486 by the extremely prolific German printer, Johannes (Hans) Grüninger (1455-1533), who specialized in religious texts.[12] Grüninger was born in Markgröningen, Württemberg, as Johannes Reinhart. He adopted the name of his home town when he moved to Basel in order to learn the printing trade. After moving to Strasbourg in 1481, he published his first volume two years later;[13] the *Gart der Gesundheit* was one of his early works.

A low German translation was produced at Lübeck by Steffan Arndes (c.1450-1519) under the title *Gaerde der Sundheit*. Seemingly quite successful, it was printed three times – in 1492, 1510 and again in 1520. Furthermore, it formed the basis for a Church Slavonic translation (1534),[14] as well as a Russian translation (1534 – *Blagoprokhladnyi vertograd*) by German physician and translator Nicolaus Bülow (c.1465-c.1548), who was personal physician to the Grand Duke Vasilij III (c.1479-1533) in Moscow.[15]

Bernard von Breydenbach (1440-1497) was a Mainz official and politician (Figure 3). On the basis of some remarks in the introductory section to the work, it was he who was responsible for commissioning the volume. Breydenbach came from a noble family and studied at Erfurt, gaining a doctorate in law. He had a prominent ecclesiastical career, becoming Canon of Mainz in 1450 and serving, successively, as Apostolic Protonotary, Chamberlain to the Courts of Justice and eventually Dean of the Cathedral.[16] He famously undertook a pilgrimage to Palestine, the Holy Land, from April 1483 until January 1484, and published an account of his travels, entitled *Peregrinatio in Terram Sanctam* ('Pilgrimage in the Holy Land') on his return in 1486. Amongst his fellow travellers was the Dutch artist, Erhard Reuwich (1450-before 1505), whose innovative illustrations in woodcut were used to enhance the text of the travelogue.

Johann Wonnecke von Kaub (sometimes Cube or Cuba, c.1430-1503/4) – the 'Master learned in Physic'

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Figure 3. *Bernard von Breydenbach (1440-1497), Dean of Mainz Cathedral. Grave plate, located in front of the Gothard Chapel, Mainz Cathedral, with an inscription that reads: Anno MCCCCLXXXXVII. die V. Mensis Maji obiit Reverendus Pater D. Bernhardus de Breidenbach S. Apostolicæ sedis Pronotarius ac hujus ecclesiæ Decanus C.A.R.I.P. (Source: Creative Commons 3.0, unmodified, Symposiarch)*

– was pressed into compiling the text for the volume.[17] He was well placed to do so, having earned a doctorate in medicine following his studies at Cologne and Erfurt, and was active as a city physician in Frankfurt am Main.[18] The entry for *Bolus Armenus* contains the information that it was often used by 'me, Meister Johann von Cube', which is the source of the suggestion as to his overall authorship of the volume.[19] It is believed that many of the high quality woodcuts depicting many of the plants referred to in the text ('with their true colours and form') were the work of Reuwich, 'a painter ready of wit, and cunning and subtle of hand'.[20]

Content of the *Gart der Gesundheit*

The *Gart* has been described as 'the most important medieval work on natural history' and 'the greatest single step in the art of botanical illustration'.[21] Published on 28 March 1485, the volume was written in German rather than Latin, a clear break with tradition. In the absence of a title page, it is generally referred to as the *Gart der Gesundheit*, from its own introduction, but has also been cited as the *Herbarius zu Teutsch*, the *German Herbarius*, the *German Hortus Sanitatis*, the *Smaller Hortus*, and *Cube's Herbal*.[22]

The medicinal plants were chosen because they 'are commonly used in apothecaries' shops for medicine', and are presented in alphabetical order in 435 chapters and supported by 381 illustrations. A brief description is given for each herbal entry, followed by an account of their properties and uses. An Index at the back of the volume provided an indispensable aid to locating the correct entry.

The Introduction to the volume provides interesting insights into the philosophical influences on contemporary medicine and the elements of the materia medica. For ease of reference, the salient parts of the Introduction are reproduced here in English translation:[23]

> Many a time and oft have I contemplated inwardly the wondrous works of the Creator of the universe: how in the beginning He formed the heavens and adorned them with goodly shining stars, to which He gave power and might to influence everything under heaven. Also, how He afterwards formed the four elements: fire, hot and dry – air, hot and moist – water, cold and moist – earth, dry and cold – and gave to each a nature of its own; and how after this the same Great Master of Nature made and formed herbs of many sorts, and animals of all kinds, and last of all Man, the noblest of all created things. Thereupon I thought on the wondrous order which the Creator gave these same creatures of His, so that everything which has its being under heaven receives it from the stars, and keeps it by their help. I considered further, how that in everything which arises, grows, lives or soars in the four elements name, be it metal, stone,

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herb or animal, the four natures of the elements – heat, cold, moistness and dryness – are mingled. It is also to be noted that the four natures in question are also mixed and blended in the human body in a measure and temperament suitable to the life and nature of man. While man keeps within this measure, proportion or temperament, he is strong and healthy, but as soon as he steps or falls beyond the temperament or measure of the four natures, which happens when heat takes the upper hand and strives to stifle cold, or, on the contrary, when cold begins to suppress heat, or man becomes full of cold moisture, or again is deprived of the due measure of moisture, he falls of necessity into sickness, and draws nigh unto death. There are many causes of disturbances, such as I have mentioned, in the measure of the four elements which is essential to man's health and life. In some cases it is the poisonous and hidden influence of the heavens acting against man's nature, for from this arise impurity and poisoning of the air; in other cases the food and drink are unsuitable, or suitable but not taken in the right quantities, or at the right time. Of a truth I would as soon count thee the leaves on the trees, or the grains of sand in the sea, as the things which are the cause of a relapse from the temperament of the four natures, and a beginning of man's sickness. It is for this reason that so many thousands and thousands of perils and dangers beset man. He is not fully sure of his health or his life for one moment. While considering these matters, I also remembered how the Creator of Nature, Who has placed us amid such dangers, has mercifully provided us with a remedy, that is with all kinds of herbs, animals and other created things to which He has given power and might to restore, produce, give and temper the four natures mentioned above. One herb is heating, another is cooling, each after the degree of its nature and complexion. In the same manner many other created things on the earth and in the water preserve man's life, through the Creator of Nature.. [...] Thereupon I caused this praiseworthy work to be begun by a Master learned in physic, who, at my request, gathered into a book the virtue and nature of many herbs out of the acknowledged masters of physic, Galen, Avicenna, Serapion, Dioscorides, Pandectarius, Platearius and others.

Listing these influences in sequence, we can see:

1. The importance of a generally Christian world view;
2. The influence of the stars and the heavens – thaumaturgic astrology;
3. The four elements and their qualities – Aristotelianism;
4. The four natures and temperaments – Hippocratic humorism;
5. Godly provision of remedies in nature – Doctrine of Signatures (implied);
6. The accumulated authority and wisdom of classical, Arabic and medieval authors.

Figure 4. *Hand coloured woodcut frontispiece from the Gart der Gesundheit, 1485. The Elisha Whittelsey Collection, The Elisha Whittelsey Fund, 1944. (Source: Metropolitan Museum of Art Open Access, CC0)*

Frontispiece of the *Gart der Gesundheit*

As if accentuating the last point, the frontispiece to the volume, which occupies a full page (Figure 4), depicts a tropical garden in which are seated a group of savants and their acolytes. This image has variously been interpreted as being a representation of Aristotle teaching his fellow physicians, the personification of Arabic wisdom imparting his knowledge, or, more popularly, a cluster of the main authorities quoted in the text – Pliny, Galen, Dioscorides, Avicenna and Serapion in particular.

The group of erudite gentlemen gracing the frontispiece is transposed into an apothecary's shop in Schönsberger's pirated edition of 1496. They occupy the foreground, whilst a working apothecary is occupied at a

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bench with a pestle and mortar, with the rather limited tools of his trade scattered on the bench surface – boxes of pills and apothecaries' scales (Figure 5). The background consists of shelving filled with apothecary jars bearing the arms of various German cities.

Figure 5. *An Apothecary's shop, frontispiece to the Gart der Gesundheit, 1496. (Source: The Wellcome Library)*

Alexandre Dubois[24] makes the point that illustrations are important components of pharmacy texts, and that:

> La raison en est évidente puisqu'elle est un important facteur de transmission de la connaissance pharmaceutique. Cependant l'illustration est loin de rester strictement documentaire et le désir de faire passer un message, la réflexion sur la place de la pharmacie dans les connaissances, l'envie de notoriété des auteurs ou leurs points de vue philosophiques sont présents dans les différentes images rencontrées et tout particulièrement dans le frontispice. Du bas latin *frontispicium*, de *frons-ontis*, front et de *spicere*, regarder, le frontispice est l'illustration placée en regard de la page de titre d'un livre ou placée sur la page de titre et dont le sujet est analogue au but et à l'esprit de l'ouvrage. C'est la façade parlante de l'ouvrage, il résume en une gravure la pensée de l'auteur.

The last two sentences of this quotation are particularly interesting, indicating that the frontispiece reflects the goals and spirit of the book, acting as a 'talking façade' which summarises in an engraving the thoughts of the author.

In the case of the *Gart*, the author's thoughts clearly range through the long history of the pharmaceutical uses of plant materials stretching from classical times through to his time of writing. A popular technique in earlier writings was to quote from the works of the acclaimed and erudite authors of the past. In this instance, the *Gart* credited its selected quotations to 34 previous authorities, although careful analysis of some of the entries indicates that some of the accreditations are spurious. The main authorities consulted include the following:

1. Pliny the Elder (Gaius Plinius Secundus; 23-79 AD), whose eclectic, encyclopaedic 37-volume Natural History, probably completed around 77 AD contains much Roman medical information and folklore.
2. Pedanius Dioscorides (circa 40-90 AD), a virtual contemporary of Pliny's, whose famous 5-volume *De Materia Medica* represents a forerunner of the pharmacopoeia.
3. Claudius Galenus (Galen of Pergamon; 129-200/216 AD), the extremely influential, highly prolific author and Greek physician who served the Roman Empire and championed the concept of humoral medicine.
4. Avicenna (circa 980-1037), the Persian polymath and possibly the most significant of the medieval Islamic authors, whose encyclopaedic *Canon of Medicine* was adopted by many medieval European universities as their standard text.
5. Serapion the Younger, about whom very little is known, and who probably wrote his Book of Simple Medicaments for physicians and apothecaries during the twelfth century.
6. Isidore of Seville (Isidorus Hispalensis; circa 560-636), the scholarly Archbishop of Seville, who wrote an extremely influential etymological encyclopaedia entitled *Etymologiae*.
7. Matthaeus Platearius, believed to have been a physician at the famous medical school at Salerno. He is credited with having written the *Circa Instans* ('The Book of Simple Medicines'), so-named from the first words of the text, during the latter part of the twelfth century.

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8. Vincent de Beauvais (Vincentius Bellovacensis; circa 1184-circa 1264), a Dominican friar at the Cistercian Royaumont Abbey (around 30 km north of Paris); his *Speculum Naturale* ('Mirror of Nature'), containing an enormous digest of medical lore, was first completed in 1244, but then he continued to work on producing a second version right up to his death.
9. Bartholomaeus Anglicus (Bartholomew the Englishman, or Berthelet; before 1203-1272), a Franciscan scholar working in Paris. His *De proprietatibus rerum* ('On the Properties of Things'), completed in 1244, whilst he was at Magdeburg, was one of the most popular and oft-cited volumes of medieval times, and was translated into English by John Trevisa in 1397.
10. Jacopo Dondi dell'Orologio (Jacopo de Dondi; 1290-1359), the Paduan physician, astronomer and celebrated and innovative clockmaker. His *Promptuarium medicinae ed Enumeratio remediorum simplicium et compositorum* ('Synopsis of simple and compound medicines') was completed in 1355 and the first print version was issued by Adolph Rusch (the 'R-Printer') in Strasbourg in 1470.

The accumulated writings of these scholars dominated thinking about the materia medica well into the seventeenth century.

Conclusion

In summary, the *Gart der Gesundheit* was an incunabular volume of exceptional importance in the development of early pharmaceutical literature. Following the medieval tradition of quoting salient facts from the writings of its predecessors, the innovations employed by the publisher in producing the printed volume set both a model and the standard for later herbals to follow and improve upon.

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Endnotes and References

1. van Miert, D. (ed.). *The Kaleidoscopic Scholarship of Hadrianus Junius (1511-1575). Northern Humanism at the Dawn of the Dutch Golden Age*. Leiden and Boston: Brill, 2011.
2. Glomski, J. Incunabula Typographiae: seventeenth-century views on early printing. *The Library*, 2001: 2; 336.
3. The Incunabula Short Title Catalogue (ISTC) is an electronic bibliographic database maintained by the British Library which seeks to catalogue all known examples.
4. Baumann, B. and Baumann, H. *Die Mainzer Kräuterbuch-Inkunabeln «Herbarius Moguntinus», «Gart der Gesundheit» und «Hortus Sanitatis»: Wissenschaftshistorische Untersuchung der drei Prototypen botanisch-medizinischer Literatur des Spätmittelalters*. Stuttgart: Anton Hiersemann, 2010; Klebs, A.C. Incunabula Lists. 1. Herbals. *The Papers of the Bibliographical Society of America*. 1917: 11; 75-92 (see page 83).
5. Mayer, JG. Die Wahrheit über den *Gart der Gesundheit* (1485) und sein Weiterleben in den Kräuterbüchern der frühen Neuzeit. In Anagnostou, S., Egmond, F., & Fredrich, C. (eds). *A Passion for Plants: Materia medica and botany in scientific networks from the 16th to 18th centuries. Quellen und Studien zur Geschichte der Pharmazie*. 2011: 95; 119-128.
6. Lehmann-Haupt, H. *Peter Schoeffer of Gernsheim and Mainz with a list of his surviving books and broadsides*. Rochester: Leo Hart, 1950: 1.
7. Lehmann-Haupt, H. (Note 6) 1950.
8. Lehmann-Haupt, H. (Note 6) 1950: 57.
9. Shaffer, E. *The Garden of Health. An account of two Herbals. The Gart der Gesundheit and the Hortus Sanitatis.* The Book Club of California: Lawton Kennedy, 1957: 13.
10. Künast, H-J. Schönsberger, Johann. In *Neue Deutsche Biographie*, 2007: 23; 421-422. https://www.deutsche-biographie.de/pnd10230534X.html#ndbcontent. Accessed 21 January 2018.
11. Baumann, B. and Baumann, H. (Note 4) 2010: 223.
12. Baumann, B. and Baumann, H. (Note 4) 2010: 223.
13. Ritter, F. and Grüninger, J. In *Neue Deutsche Biographie*. 1966: 7; 201. https://www.deutsche-biographie.de/pnd118698451.html#ndbcontent. Accessed 21 January 2018.
14. Mathieson, R. Magic in Slavia Orthodoxa: The Written Tradition. In Maguire, H. (ed.) *Byzantine Magic*. Washington, DC: Dumbarton Oaks Research Library and Collection, 1995: 169.
15. Henning, A. [The formation of medical knowledges in Russia before 1800: contributions of German speaking physicians]. *Würzburger medizinhistorische Mitteilungen*. 2004: 23; 428-435. Ryan, W. Alchemy and the Virtues of Stones in Muscovy, 149-160. In Rattansi, P. and Clericuzio, A. (eds) *Alchemy and Chemistry in the 16th and 17th centuries*. London: Kluwer Academic Publishers, 1994: 152.
16. Davies, HW. *Bernhard von Breydenbach and his journey to the Holy Land 1483-4*. London: J & J. Leighton, 1911: i.
17. Shaffer, E. (Note 9) 1957: 9.
18. Keil, G. Johann Wonnecke (Dronnecke) von Kaub (J. de Cuba) (Wonnecke, Johann, von Caub). In Gerabek, W. E., Haage, B.D., Keil, G., & Wegner, W. (eds.), *Enzyklopädie Medizingeschichte*. Berlin and New York: De Gruyter, 2005: 700.
19. Shaffer, E. (Note 9) 1957: 7.
20. Shaffer, (Note 9) 1957: 9; note this view has been challenged by Blunt, W. *The Art of Botanical Illustration.* London: Collins, 1950 and Timm, F. *Der Palästina-Pilgerbericht des Bernhard von Breidenbach und die Holzschnitte Erhard Reuwichs. Die Peregrinatio in terram sanctam (1486) als Propagandainstrument im Mantel der gelehrten Pilgerschrift*. Stuttgart: Hauswedell Verlag, 2006.
21. Shaffer, E. (Note 9) 1957: 6.
22. Shaffer, E. (Note 9) 1957: 6.
23. Shaffer, E. (Note 9) 1957: 8-9.
24. Dubois, A. Analyse de quelques frontispices d'ouvrages pharmaceutiques du XVIIe siècle issus des collections des bibliothèques de Rouen. *Revue d'histoire de la pharmacie*. 2004: 92(344); 559.

https://doi.org/10.24355/dbbs.084-202009111211-0